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HYDRO-ELECTRIC INQUIRY COMMISSION

ENGINEERING DATA

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

STUDY OF CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

WALTER J. FRANCIS & COMPANY

CONSULTING ENGINEERS

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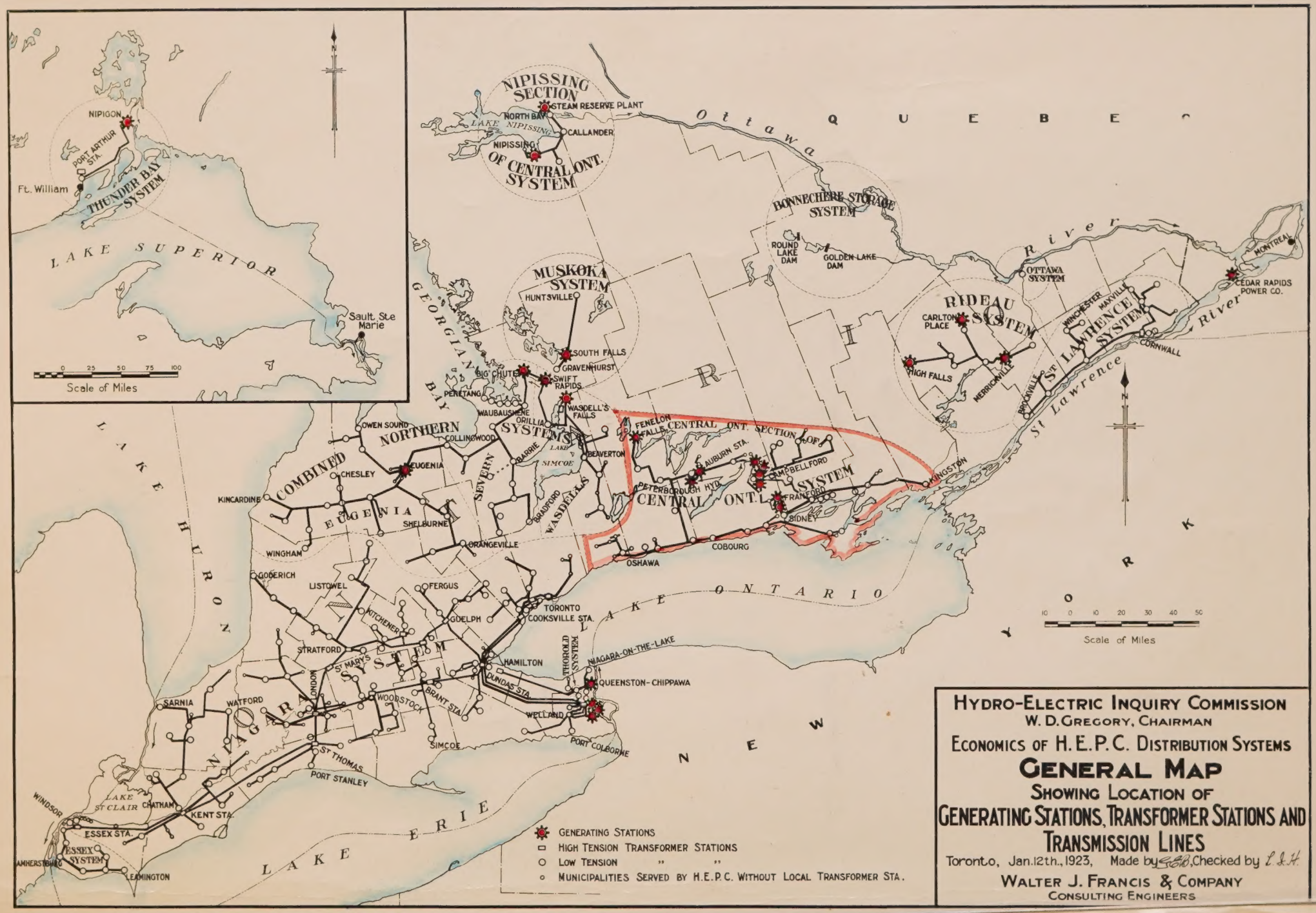
CENTRAL ONTARIO (TRENT) SECTION

OF THE

CENTRAL ONTARIO SYSTEM


HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN
ECONOMICS OF H.E.P.C. DISTRIBUTION SYSTEMS
GENERAL MAP
SHOWING LOCATION OF
GENERATING STATIONS, TRANSFORMER STATIONS AND TRANSMISSION LINES
Toronto, Jan. 12th., 1923, Made by G.S.B., Checked by L.J.H.
WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
GENERATING STATIONS
HIGH TENSION TRANSFORMER STATIONS
LOW TENSION " "
MUNICIPALITIES SERVED BY H.E.P.C. WITHOUT LOCAL TRANSFORMER STA.
Scale of Miles
NIPISSING SECTION OF CENTRAL ONT. SYSTEM
STEAM RESERVE PLANT
NORTH BAY
CALLANDER
NIPISSING
LAKE NIPISSING
THUNDER BAY SYSTEM
NIPIGON
PORT ARTHUR STA.
Ft. William
LAKE SUPERIOR
Sault Ste Marie
MUSKOKA SYSTEM
HUNTSVILLE
SOUTH FALLS
GRAVENHURST
BIG CHUTE
SWIFT RAPIDS
WASDELL'S FALLS
PENETANG
WAUBAUSHENE
ORILLIA
BEAVERTON
LAKE SIMCOE
GEORGIAN BAY
BONNECHERE STORAGE SYSTEM
ROUND LAKE DAM
GOLDEN LAKE DAM
OTTAWA SYSTEM
RIDEAU SYSTEM
CARLTON PLACE
HIGH FALLS
MERRICKVILLE
BROCKVILLE
WINCHESTER
MAXVILLE
ST LAWRENCE SYSTEM
CORNWALL
CEDAR RAPIDS POWER CO.
MONTREAL
Ottawa River
St Lawrence River
QUEBEC
NEW YORK
LAKE ONTARIO
LAKE ERIE
LAKE HURON
LAKE ST CLAIR
COMBINED NORTHERN SYSTEMS
OWEN SOUND
COLLINGWOOD
EUGENIA
CHESLEY
KINCARDINE
SHELBURNE
WINGHAM
GODERICH
LISTOWEL
ORANGEVILLE
SEVERN
BRADFORD
WASDELL'S
FENELON FALLS
CENTRAL ONT. SECTION OF CENTRAL ONT. SYSTEM
AUBURN STA.
PETERBOROUGH HYD.
CAMPBELLFORD
FRANKFORD
BIDNEY
KINGSTON
COBOURG
OSHAWA
TORONTO
COOKSVILLE STA.
FERGUS
GUELPH
KITCHENER
STRATFORD
ST MARYS
LONDON
NIAGARA SYSTEM
HAMILTON
DUNDAS STA.
THOROLD SYSTEM
NIAGARA-ON-THE-LAKE
QUEENSTON-CHIPPAWA
WELLAND
PORT COLBORNE
WOODSTOCK
BRANT STA.
SIMCOE
ST THOMAS
PORT STANLEY
SARNIA
WATFORD
CHATHAM
KENT STA.
WINDSOR
ESSEX STA.
ESSEX SYSTEM
AMHERSTBURG
LEAMINGTON

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO Mr. J. Allan Ross.

To face frontispiece.

General Map Showing Location of

Generating Stations, Transformer Stations and Transmission Lines

of the

Hydro-Electric Power Commission of Ontario.

COPY

The area outlined in red shows the

Central Ontario (Trent) Section of the

Central Ontario System.

WALTER J. FRANCIS & COMPANY

Copy for enclosure to Mr. J. Allan Ross.

To Tune Provincialione.

General Map showing location of

Generating Stations, Transformer Stations and Transmission Lines

of the

Hydro-Electric Power Commission of Ontario.

COPY

The area outlined in red shows the

Central Ontario (Power) section of the

Central Ontario System.

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(Index)

INDEX TO CENTRAL ONTARIO (TRENT) SECTION OF THE CENTRAL ONTARIO SYSTEM

COPY

INDEX TO CENTRAL ONTARIO (TRENT) SECTION
OF THE
CENTRAL ONTARIO SYSTEM

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(Illus.)

LIST OF ILLUSTRATIONS

CENTRAL ONTARIO (TRENT) SECTION OF THE CENTRAL ONTARIO SYSTEM

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WALTER J. FRANCIS & COMPANY.

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LIST OF ILLUSTRATIONS

CENTRAL ONTARIO (TRENT) SECTION
OF THE
CENTRAL ONTARIO SYSTEM

COPY

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO Mr. J. Allan Ross.

Toronto, Ontario,

January 5th, 1923.

Hydro-Electric Inquiry Commission,
W. D. Gregory, Esq., Chairman,
T O R O N T O, Ontario.

re Studies of Engineering Economics of the
Central Ontario Section of the Central Ontario System of the
Hydro-Electric Power Commission of Ontario

Mr. Chairman and Gentlemen,-

In accordance with the letter to your Commission under date of November 4th, and your confirmation of the general instructions under date of November 15th, a study has been made of the engineering economics of the Central Ontario System of electrical generation and distribution and of the allied subsidiaries operated by the Hydro-Electric Power Commission of Ontario. The work has been done under the direct personal supervision of Mr. Frederick B. Brown, M.Sc., M.E.I.C., a partner in the firm of Walter J. Francis & Company, in accordance with your instructions.

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The subject has been discussed with Mr. Commissioner P. A. Ross in detail, and, generally, with Mr. Bower, the Secretary of your Commission, and constant communication has been maintained with the officials of the Hydro-Electric Power Commission of Ontario.

The reports of Messrs. Price, Waterhouse & Co., and of Messrs. Clarkson, Gordon and Dilworth have been used as the basis of the financial figures given herein, and reference has been made to the records of the Hydro-Electric Power Commission of Ontario where it was necessary to do so to prepare the diagrams.

It is understood that it is not within the scope of the instructions to examine into any of the legal aspects of the system nor discuss any of the Acts of the Legislature relating to it.

The necessary technical data has required considerable preparation as much of it is only available in the operating records of the Hydro-Electric Power Commission of Ontario. The printed reports contain a part, but these have had to be supplemented by interviews with various officials and by searching the voluminous records both at the head office in Toronto and elsewhere.

The general plan under which the report of the studies is presented may be outlined as follows:

COPY

(1) A short review of the history and evolution of the System.

(2) A brief physical description of the System.

(3) A brief discussion regarding the characteristics of the local market.

(4) A discussion of progressive capital costs.

(5) Statistics regarding progressive revenues for various classes of service with discussion thereon.

(6) Statistics regarding progressive operating costs and fixed charges with discussion thereon.

(7) Statistics showing progressive and accumulated deficits or surpluses with discussion thereon.

(8) Analysis of progressive operating records and of unit revenues per kilowatt hour and per horse-power per annum and of unit costs per kilowatt hour and per horse-power per annum.

(9) A brief discussion of the various important points concerning the system.

The report included herewith as pages 4 to 92 inclusive refers in detail only to that portion of the Central Ontario System known as the Central Ontario (Trent) Section. The other part of the Central Ontario System is called the Nipissing Section, and is being dealt with in a separate document.

Throughout the report diagrams have been included in the order of the text, referring to the Central Ontario (Trent) Section only, while the map included as the frontispiece shows the Section generally and its geographical relation to the Nipissing Section and to all the other systems operated by the Hydro-Electric Power Commission of Ontario.

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CENTRAL ONTARIO (TRENT) SECTION OF THE CENTRAL ONTARIO SYSTEM.

Frederick B. Brown, M. Sc.

Evolution and Development of the System.

The Central Ontario System consists of two distinct parts operated under one system of accounting, namely, the Central Ontario (Trent) Section, and the Nipissing Section. The system is the result of the gradual development of electrical service by a number of independent companies from about the year 1900, which were finally amalgamated under the control of one company known as the Electric Power Company, Limited. Prior to March 1st, 1916, the Electric Power Company, Limited, consisted of twenty-two separate companies serving the districts with the usual electric light and power service as well as with gas and water in certain places. These companies were as follows: Auburn Power Company, Limited; Central Ontario Power Company; City Gas Company of Oshawa, Limited; Cobourg Utilities Corporation, Limited; Cobourg Water & Electric Company; Cobourg Gas, Light & Water Company; Eastern Power Company, Limited; Light, Heat and Power Company of Lindsay; Napanee Gas Company, Limited; Napanee Water & Electric Company; Nipissing Power Company, Limited; Northumberland Pulp Company, Limited; Oshawa Electric Light Company; Otonabee Power Company, Limited; North Bay Light, Heat & Power Company; Peterborough Light & Power Company, Limited; Peterborough Radial Railway Company; Port Hope Electric Light & Power Company; Seymour Power & Electric Company, Limited; Sidney Electric Power Company, Limited; Trenton Electric and Water Company, Limited; Tweed Electric Light & Power Company, Limited.

COPY

About the year 1913, the activities of the Hydro-Electric Power Commission of Ontario were commencing to extend eastwards from Toronto into the Central Ontario district, and about the same time the activities of large private power companies were extending westwards from Montreal and eastern Ontario. This finally resulted in an agreement between the Electric Power Company, Limited, and the Government of the Province of Ontario, whereby the Government purchased all of the assets and undertakings of the Electric Power Company, Limited, under an agreement dated March 10th, 1916, which arranged for the transfer of the properties of the Electric Power Company, Limited, as at March 1st, 1916, the consideration being the sum of $8,350,000.00, in 10-year 4 per cent. bonds of the Ontario Government. This arrangement was confirmed by the assent of the Lieutenant-Governor being given to the Central Ontario Power Act on April 27th, 1916. It was arranged that the management of the properties so taken over would be vested in the officials of the Electric Power Company, Limited, up to June 1st, 1916, since which time the Hydro-Electric Power Commission of Ontario has been operating the System on behalf of the Province and has extended the service beyond the limits of 1916, until at the present time it is supplying power in about thirty municipalities and townships, as well as to a large number of individual consumers at different points on the System.

COPY

Description of the System.

General.

The Central Ontario System comprises two distinct portions, one known as

the Central Ontario (Trent) Section, which extends from Whitby on the west to and including the city of Kingston on the east, and from the Lake Ontario water-front northwards as far as Lindsay. The Nipissing Section supplies North Bay, Callender, Powassan and Nipissing. For the purposes of discussion and analysis, the two sections of the System have been considered separately. The discussion of the Central Ontario (Trent) Section is here presented first as a whole, and the Nipissing Section report will follow later.

The map included as a frontispiece shows the whole of the transmission systems of the Hydro-Electric Power Commission with the location of generating stations, high tension transformer stations, high tension transmission lines and low tension transformer stations clearly indicated, and shows the various systems in their relation to one another. The tinted portion of the map indicates the Central Ontario System, and shows the relation of the Central Ontario Section to the Nipissing Section.

COPY

The map included as page 7 shows the Central Ontario Section on a larger scale than the frontispiece, and gives also the names of the principal centres concerned.

Generating Stations and Other Sources of Power Supply, Trent Section.

The following table gives a list of the various generating stations as taken over as at March 1st, 1916, together with the extensions made thereto up to October 31st, 1922. The table includes the capacity or rating of each generating station in accordance with the practice of the Hydro-Electric Power Commission, and is expressed in horse-power at 80 per cent. power factor. The

Generating Stations

Transformer Stations Owned By Ontario Government

Municipalities served by H.E.P.C. without Local Trans'r. Sta.

Note:-

Transmission Line Voltage shown thus 44,000

Hydro-Electric Inquiry Commission

W. D. Gregory, Chairman

Economics of H.E.P.C. Distribution Systems

Central Ontario System

Central Ontario Section

Map Showing Location of Generating Stations, Transformer Stations and Transmission Lines

Toronto, Jan 5th., 1923. Made by [illegible] Checked by [illegible]

Walter J. Francis & Company

Consulting Engineers

(7)

rating of the Ranney Falls plant is given as the average between Summer and Winter Power:

Table of Generating Stations

Location	Name	H.E.P.C. Developed Rating 1916	H.E.P.C. Developed Rating 1922
		H.P.	H.P.
Dam No. 2.	Trenton (Sidney)	4,000	4,000
No. 5.	Frankford	3,470	3,470
No. 10.	Ranney Falls	———	10,000
No. 11.	Campbellford (Seymour)	4,000	4,000
No. 14.	Healey's Falls	8,000	12,000
No. 18.	Peterborough (Auburn)	2,000	2,000
No. 30.	Fenelon Falls	930	930

COPY

Later in the report certain of these plants will be discussed more fully. A number of further details concerning the developed plants of the Section is given in the report entitled "Principal Characteristics of H.E.P.C. Plants" by Mr. Walter J. Francis, under date of November 10th, 1922, and addressed to the Hydro-Electric Inquiry Commission. Practically all of these developments were constructed in such a manner as to use the levels of the Trent and Otonabee Rivers which had been established by the Department of Railways and Canals, Canada, in connection with the Trent Canal works. The dams for practically all of these developments were constructed and are owned by the Department of Railways and Canals, Canada, and water rentals are charged to the Hydro-Electric Power Commission of Ontario. In considering the capital cost figures it must therefore be borne in mind that a considerable portion of the usual hydro-electric plant costs are not included in the figures for the plants of this

Ruling of the Ontario Motion Picture Act which has been between Canada and [illegible]

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

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[illegible] a number of Brazilian Catholic concerns, the Jornal Quanto of the Section in [illegible] Sir. Walter J. Brennin, under date of December 10th, 1941, and addressed to the [illegible] Motion Picture, Publicity and [illegible] Commission, in such a manner as to use the levels of the Brazil and Brazilian [illegible] which had been established by the Department of Religious and Morals, Canada. In connection with the "Most Loved Women". The dues for practically all of these Corporations were authorized and are owned by the Government of Hollywood and Canada, Canada, and other majorities are charged to the Euro-Atlantic Power Commission of Canada. In consideration the capital over figures it may therefore be borne in mind that a considerable portion of the usual Hollywood-Canadian films cases are not included in the figures for the figures of film

Section. The control of the water of the Otonabee River and of the Trent River is vested in the Department of Railways and Canals, Canada, primarily for navigation purposes, and it is understood that at present the Hydro-Electric Power Commission of Ontario has no control over the regulation of the flow which supplies the water to the various plants above described, but that this subject is now under consideration by the Federal Government and the Commission.

In addition to the developed power sites as indicated in the table above, the Province of Ontario owns or controls a number of undeveloped power sites at various points which are set forth in detail in the following table:-

Table of Undeveloped Power Sites

COPY

	Trenton	Meyersburg	Meyersburg	Otonabee	Burleigh Falls	Buckhorn
Name of River and Location	Trent (Dam 1)	Trent Lock 10 (Dam 9)	Trent Locks 8 & 9 (Dam 8)	Otonabee (Dams 4&5)	Otonabee	Otonabee
Drainage Area square Miles	4840	4400	4400	2800	2540	2285
Minimum Precipitation per Annum in Inches	c 23.1	23.1	23.1	23.1	23.1	23.1
Mean Precipitation per Annum in Inches	c 32.3	32.3	32.3	32.3	32.3	32.3
Minimum Mean Monthly Run Off C.F.S.	f 820	f 820	f 820	f 750	f 250	f 250
Mean Run Off per Annum C.F.S.	af 1400	af 1400	af 1400	f	f	f
Minimum Available Head Feet	17	e 17	35½	24	28	8
Mean Available Head Feet	d 17	24	35½	24	28	8
Years of Precipitation Records	1883-1914	1883-1914	1883-1914	1883-1914	1883-1914	1883-1914
Years of Gauging Records	1911-1921	1911-1921	1883-1914	1911-1921	1911-1921	1911-1921
Water Horse-power Mean	2700	3800	5500	f 2000	f 800	f 230
Water Storage Million Cubic Feet	b 3500	b 3500	b 3500	b 3000	b 1260	b 1260

The notations in the foregoing table indicated by letters are to be interpreted as follows:

a Possible regulated minimum.
b Storage in lakes of main canal system.
c Records of four stations in or adjoining drainage basin.
d Level difference between regulated reaches.
e Winter head.
f Under control of Department of Railways and Canals.

The data given in the above table has been supplied by the officials of the Hydro-Electric Power Commission in accordance with our request.

In addition to the developed plants and the undeveloped power sites, there are a few steam stand-by plants and other power rights of minor importance, but none of these has been called upon for service to any extent. The details of these may be found in two reports of Messrs. Clarkson, Gordon and Dilworth, one entitled "Details of Plant Costs as at September 30th, 1922", and the other entitled "Analysis of Assets as at March 1st, 1915", both of which documents are in the files of the Hydro-Electric Inquiry Commission.

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As a further source of power supply, contracts have been made on behalf of the Province with two private plants in the district, namely, the Peterborough Hydraulic Power Company of Peterborough, which is owned by the interests controlling the Quaker Oats Company in that city, from which plant an amount of power up to 1,500 kilowatts is available as secondary power, and averaging about 1,050 kilowatts, for use by the Hydro-Electric Power Commission, and the plant owned by the municipality of the town of Campbellford in that place, from which approximately 1,200 kilowatts of primary power is available for the use of the Commission.

The rates at which power is purchasable from these two plants are as

COPY

follows:

Peterborough Hydraulic Power Company, 0.375¢ per kilowatt hour for all power supplied.

Campbellford Municipal Plant, 50¢ per kilowatt per month plus 0.1¢ per kilowatt hour, with a minimum monthly bill of $450.00.

The Peterborough contract has been in force since a date prior to March 1st, 1916, while the Campbellford contract was arranged in July of 1921.

Transmission Lines.

At the time of the purchase of the Electric Power Company, Limited, by the Ontario Government, there were in existence about 285 miles of high tension transmission lines, consisting for the most part of a 44,000-volt network, with a tie line from Fenelon Falls to Lindsay, operating at 11,000 volts, and another tie line from Trenton to Frankford operating at 6,600 volts.

COPY

Since 1916, the transmission system has been greatly extended until at the present time it consists of nearly 500 miles of lines made up of approximately 390 miles at 44,000 volts, 13 miles at 11,000 volts, 36 miles at 6,600 volts, 33 miles at 4,160 volts, 7 miles at 4,000 volts, and about 10 miles at 2,400 volts.

Transformer Stations.

The transmission network feeds a number of high voltage sub-stations, and low voltage sub-stations, the location of which are shown on the map on page 7. The following table gives a general list of these stations with their capacity and voltage:

Table of Transformer Stations

Location	K.V.A. Capacity	Voltage H.T.	Voltage L.T.	Remarks
Belleville	2,250	44,000	2,400	
Belleville, Lehigh Cement Co.	3,000	44,000	600	
Belleville, Belleville Cement Co.	2,250	44,000	600	
Bowmanville	1,500	44,000	2,400	
Brighton	300	44,000	2,400	Feeds Smithfield
Campbellford, Northern Pulp Mill	2,250	44,000	2,400	
Cobourg	600	44,000	2,400	
Colborne	100	44,000	2,400	
Delore	750	44,000	600	
Deseronto	600	44,000	2,400	
Kingston	2,250	44,000	2,400	
Lakefield	225	6,000	4,160	From Auburn G.S.
Lindsay	1,500	44,000	2,400	
Lindsay	750	11,000	2,400	
Madoc	900	44,000	4,160	
Marmora	50	44,000	2,400	
Millbrook	100	44,000	2,400	
Napanee	600	44,000	2,400	Feeds Newburg & Camden
Newcastle	100	44,000	2,400	Feeds Orono
Norwood	300	44,000	4,160	
Omemee	120	44,000	2,400	
Oshawa	5,250	44,000	4,160	Feeds Whitby, Oshaw Rural, etc.
Peterborough	3,000	6,000	2,400	
Picton	300	44,000	2,400	
Point Anne	600	44,000	600	
Port Hope	480	44,000	2,400	
Sulphide	1,050	44,000	4,160	
Sulphide Nichols Chemical Co.	225	2,200	220	
Trenton	750	6,600	4,160	
Trenton	600	6,600	2,400	
Wellington	300	44,000	4,160	Feeds Bloomfield

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Local Distributing Systems.

The Central Ontario System is somewhat different from most of the other systems operated by the Hydro-Electric Power Commission of Ontario, because in

the majority of the municipalities the local electric systems are operated directly by the Hydro-Electric Power Commission acting as trustee for the Province. In the remainder the electricity is distributed retail by the municipality itself as is common on the other systems elsewhere in the Province, and in these each municipality purchases energy wholesale from the Hydro-Electric Power Commission at a sub-station and metering point in the municipality or nearby and distributes to the citizens, the Hydro-Electric Power Commission having nothing to do with the actual operation of the local system. The accounting, however, is done in accordance with the standards of the Hydro-Electric Power Commission of Ontario, and reports are submitted periodically and summarized in the Annual Report of the Commission. The accounting for the fifteen municipalities in which the Hydro-Electric Power Commission distributes directly in this Section is apparently not kept in the same manner but is included in the general accounts of the Commission for the System and the details in the various municipalities are not given in the Annual Report.

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The fifteen municipalities in which the Commission distributes directly to the consumer are as follows: Belleville, Bowmanville, Brighton, Cobourg, Deseronto, Lindsay, Millbrook, Napanee, Newburgh, Newcastle, Orono, Oshawa, Port Hope, Trenton and Tweed. In these municipalities the Commission retails power to the consumer at fixed rates governed as to their maximum by franchises granted to the subsidiary companies of the Electric Power Company, Limited, prior to March 1st, 1916. It should be noted that a number of these franchises have expired and that no subsequent agreements have been made. The details of these are given in Exhibit XXX of the report of Messrs. Price, Waterhouse

& Co. on the accounting of the System under date of October 26th, 1922, Hydro-Electric Inquiry Commission file No. 189-A. Certain of these municipalities also have the right to purchase their local distribution system without having to pay for intangible values.

Eight municipalities receive power at cost on a basis similar to that outlined under Section 23 of the Power Commission Act of 1914, with the exception that no provision for sinking fund has so far been included in the cost of power, although it is distinctly stipulated in the contracts with each of the municipalities that sinking fund on a 30-year basis shall be paid as a part of the cost of power. These are as follows: Peterborough, Bloomfield, Wellington, Picton, Lakefield, Marmora, Norwood and Havelock. Peterborough has been served on this basis since 1913, Bloomfield, Wellington and Picton since 1919, Lakefield and Marmora since 1920, and Norwood and Havelock since 1921.

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Electrical energy is supplied to the municipalities of Kingston and Omemee, and to the Seymour Township at fixed rates in accordance with contracts made with the Commission.

The municipalities of Madoc and Stirling are similarly supplied in accordance with contracts made with a subsidiary of the Electric Power Company, Limited, before March 1st, 1916.

The townships of Whitby, East Whitby, and Pickering are receiving power at cost under the operation of the Oshawa rural district lines which are operated by the Commission in accordance with the Power Commission Act of 1914.

Individual Power Consumers.

In addition to the various municipalities served by the System there are a large number of individual power contracts which were made either with the Electric Power Company, Limited, or its subsidiaries prior to March 1st, 1916, or with the Hydro-Electric Power Commission itself since that date. A few of the more important are given in the table below:

Examples of Contracts at Fixed Rates

Consumer	Base Rate $ per H.P. per Annum	Cents per K.W.H. for Usage of Rated Capacity per Month			Expiry Date	Notes
		First 50 Hrs.	Second 50 Hrs.	All Additional		
Asbestos Pulp Co.	32.50	-	-	-	Aug.1921	Renewed Aug.1921
Canadian Paperboard	12.00	2.33	1.56	0.167	Jan.1923	
Canada Cement Co.	6.00 & 11.76	-	-	-	Mar.1925 or 1940	Canada Cement Co. has option to renew for fifteen years contract dated 1910.
Chemical Products Ltd.	9.00	1.6	1.0	0.15	Nov.1921	Renewed Nov.1921
Department of Railways and Canals	12.00	-	-	-	Continuous	
Deloro Smelting & Refining Co.	29.00	-	-	-	Dec.1924	
Frankford Cooperage Co.	12.00	2.33	1.56	0.167	Apr.1922	Still in effect
Gillespie & Co.	32.50	-	-	-	Nov.1921	Renewed Nov.1921
Nichols Chemical Co.	40.00	-	-	-	Aug.1921	Renewed Aug.1921
Point Anne Quarries	31.00	-	-	-	Mar.1921	Renewed Mar.1921
Stirling, Corporation of	20.00	-	-	-	Jan.1930	Contract dated 1909
Whitby, Corporation of	29.00	-	-	-	-	Interim rate. No contract.
Kingston, Corporation of	28.00	-	-	-	1938 (?)	Twenty years from first supply
Ontario Rock Co.	31.00	-	-	-	June 1930	

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The study of the operating results of these consumers indicates that the Canada Cement Co. contract is a heavy burden on the enterprise.

Other Properties Operated.

When the undertaking of the Electric Power Company, Limited, was taken over in 1916, there were a number of other properties besides electrical systems included in the transfer. These consisted of (a), gasworks in the municipalities of Oshawa, Peterborough, Cobourg and Napanee, (b), waterworks in Cobourg and Trenton, (c), a pulp mill at Campbellford, and (d), the Peterborough Radial Railway. Since 1916 these various industries have been operated by the Commission. On January 1st, 1919, the Trenton Waterworks was sold to that municipality. In 1917 about 40,000 acres of pulpwood and timber lands were acquired by the Government in Bruton Township to ensure a supply of wood for the Campbellford pulp mill property, and since 1918 these areas have been operated by the Commission. In 1919 and 1920 a barking mill was built by the Commission at Bancroft and has since been operated by it. On August 31st, 1921, the Napanee Gasworks was closed because the property was badly run down and it was stated that it would cost too much to bring it to proper operating efficiency, having in mind the possible revenues. The Campbellford pulp mill was closed during the period from March 16th, 1921, to September 11th, 1922.

At the present time, therefore, the Commission is operating gasworks at Oshawa, Peterborough and Cobourg, waterworks in Cobourg, the Campbellford pulp mill with the pulp wood lands, and the Peterborough Radial Railway, as industries separate from the electrical business of the Commission. A very brief description

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of these is as follows:

The gasworks in each municipality consists of a generating plant, pipes for distribution, and certain meters. The rates for gas are determined from year to year.

The Cobourg waterworks consists of a pumping station with a stand-by pump on the lake front driven by gasoline and steam, and the necessary water pipes and meters required in furnishing water to the consumers. The source of supply is Lake Ontario, and the water is purified by means of pressure filters. The franchise in effect in 1916 governed the rates until October 1919, since which time the rates have been as agreed upon between the Commission and the Municipal Council of Cobourg.

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The Campbellford pulp mill is located at Campbellford, being nominally rated at 30 tons per day, and there is also a barking mill at Bancroft, and approximately 40,000 acres of pulp wood and timber lands in Bruton Township, about 5,000 acres of which are waste and water lands.

The electric railway property, known as the Peterborough Radial Railway, has been in existence for many years, and at the present time consists of nearly nine miles of track, and between twenty and twenty-five cars, most of which are of comparatively old type, and two of which are the one-man safety type. This property is operated under a franchise granted to a subsidiary of the Electric Power Company, Limited, before March 1st, 1916.

Characteristics of Market.

General.

The district served by the Central Ontario Section of the Central Ontario System is both urban and rural and is of the most widely varying character with regard to the electrical load conditions.

In some municipalities the bulk of the load is required for manufacturing power purposes, while in others the greater proportion is for domestic use. Speaking broadly, the total consumption of energy in a year may be divided into three main groups, (a), private companies and industries taking power at fixed rates, (b), municipalities and industries taking wholesale power at cost; and, (c), municipalities in which power is distributed retail.

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An analysis of these three load classifications indicates that the first class uses 25 per cent. to 30 per cent. of the total energy required, the second class is about the same, while the third class required 40 per cent. to 50 per cent. of the total energy. The number of consumers in the first two classes is comparatively small, there being about a score of wholesale consumers at fixed rates, and about a dozen wholesale consumers at cost rates.

Taken as a whole, the Central Ontario Section of the Central Ontario System may be described as a well-balanced general distribution system, the varied character of the loads in different places permitting some diversity in distribution. The average yearly output is about one-half of the maximum demand while the total wholesale power billed throughout the Section is slightly greater than the peak demand.

Population Served and Percentage of Consumers to Population.

The total population served by the Central Ontario Section is approximately 140,000 persons, the total number of consumers being about 28,000 at the end of 1922. This shows that about 20 per cent. of the total population are rated as consumers on this section of the System. The table below gives in detail the number of consumers at the end of the fiscal year 1921 in most of the municipalities served by the Section, the total population in each place, the approximate horse-power billed to each place in 1921, and the kilowatt hours consumed in each place in 1921, together with the average horse-power and kilowatt hours per consumer for 1921. The townships are not included in the table. The figures in the table will probably prove useful for comparison with similar systems elsewhere, although they should be used with caution for such a purpose. It will be noted that there are considerable variations between the municipalities themselves. This is to be expected knowing that places like Peterborough, Bowmanville and Oshawa are manufacturing centres, whereas municipalities such as Marmora, Omemee, Brighton, Port Hope and others are largely residential with very few factories. For this reason it is difficult to draw conclusions when comparing one system with another, or even one place with another although they may be in the same vicinity. The only deduction which has been drawn from the figures is in respect of average conditions throughout the district. These averages are as follows:

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Average H.P. Billed per Consumer	0.67
Average H.P. Billed per Capita	0.15
Average K.W.H. Billed per Consumer	2,067
Average K.W.H. Billed per Capita	465

Table of Market Statistics

Municipality	Population	Consumers	Percentage Consumers to Population	H.P. Billed 1921	Kilowatt Hours 1921	Billed H.P. per Consumer	Kilowatt Hours per Consumer
Bloomfield	550	97	17.6	33.4	51,027	0.34	526
Havelock	1,266	302	23.8	16.4	120,440	0.05	400
Kingston	22,368	4,047	18.1	1,847.8	8,184,600	0.41	2,020
Lakefield	1,146	232	20.2	110.8	190,081	0.48	820
Marmora	853	154	18.0	11.4	50,770	0.07	330
Norwood	711	204	28.7	9.0	61,000	0.04	299
Omemee	557	120	21.5	48.0	103,960	0.40	866
Peterborough	21,790	5,521	25.3	4,513.7	14,060,250	0.83	2,550
Picton	3,189	885	27.7	269.6	869,521	0.30	980
Wellington	850	173	20.3	69.3	141,564	0.40	818
Whitby	3,975	1,000 abt.	-	397.6	1,399,224	-	1,400
Belleville	12,243	2,878	23.5	1,727.6	5,773,960	0.62	2,004
Bowmanville	3,250	813	25.0	1,113.9	3,391,160	1.37	4,170
Brighton	1,375	419	30.5	111.2	300,160	0.26	718
Cobourg	5,108	1,075	21.0	724.7	2,201,760	0.67	2,045
Deseronto	1,928	300	15.5	313.2	659,230	1.04	2,194
Lindsay	7,840	1,860	23.5	1,375.6	4,148,500	0.74	2,250
Millbrook	733	177	24.1	34.9	96,000	0.20	542
Napanee	2,847	711	25.0	417.1	1,058,350	0.59	1,490
Newcastle	619	163	26.3	35	80,240	0.21	490
Newburg	434	105 abt.	-	240.3	138,542	2.29	1,310
Orono	700	153	21.9	35	80,240	0.23	525
Oshawa	12,246	2,819	23.0	3,415.7	9,048,098	1.21	3,210
Port Hope	4,567	1,094	22.9	531.9	1,444,680	0.51	1,320
Trenton	5,576	1,420	25.5	690.5	2,041,880	0.49	1,440
Tweed	1,268	333	26.3	94.7	219,840	0.28	670
	117,989	27,055	22.9	18,288.3	55,915,097	0.676	2,067

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The table below shows the number of consumers at the end of each fiscal year from 1916 to 1922 inclusive, in each of the fifteen municipalities in which Hydro-Electric Power Commission distributes retail. The figures from which the table was compiled were supplied by the Manager of the Central Ontario Section. The details for these fifteen municipalities are not regularly published in the

COPY

Annual Reports of the Hydro-Electric Power Commission.

Table of Consumers in Fifteen Municipalities

Municipality	Number of Consumers at End of Fiscal Year						
	1916	1917	1918	1919	1920	1921	1922
Belleville	1790	1995	2140	2342	2666	2878	3040
Bowmanville	680	669	638	720	777	813	905
Brighton	362	353	358	377	404	419	423
Cobourg	631	717	784	855	973	1075	1154
Deseronto	210	179	186	210	259	300	326
Lindsay	1297	1462	1552	1640	1748	1860	1963
Millbrook	165	164	163	168	172	177	183
Napanee	546	559	577	612	656	711	757
Newcastle	147	143	146	148	148	163	170
Newburgh Line	90	90	93	103	105	105	109
Orono	131	127	133	140	149	153	163
Oshawa	1419	1529	1635	1900	2526	2819	3213
Port Hope	890	868	892	976	1004	1094	1167
Trenton	974	1034	1162	1242	1322	1420	1391
Tweed	250	274	295	310	332	333	351
Total	9582	10154	10754	11743	13241	14320	15315

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Growth of Market and Ultimate Sources of Power Supply.

From the above table it will be seen that the number of consumers in these fifteen municipalities has grown more than fifty per cent. since the System was taken over in 1916. The growth of the load on the whole of the Central Ontario Section has also kept pace with the growth in the number of consumers, the peak demand having increased over sixty per cent. between 1916 and 1922. Making allowance for the abnormal conditions in 1917, 1918 and 1919, the growth of the load has been rapid and steady.

Judging by the ratio of consumers to population and by the horse-power and

kilowatt hours used per consumer and per capita, it might be considered that the load at the present time is approaching what was formerly considered the ordinary saturation point of similar systems. On the other hand, the power demand in a number of places seems to be steadily increasing and at a faster rate than the growth of population. It is therefore difficult to estimate whether the future growth will be at a similar rate to that which has taken place during the past seven or eight years. The indications are that the increase in the demand will require further sources of power supply in the immediate future.

The situation at present is that there is little or no margin between the power available and the peak demands on the system. In fact, in July of 1922 there was actually a considerable shortage in the available power to meet the demand at that time.

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It is understood that the Hydro-Electric Power Commission has in mind the development of Dam No. 8 and Dam No. 9 at Meyersburg in the near future either as a combined development or as two separate plants. If the power demand continues to grow at anything like the recent rate it is certain that the development of these sites would meet the requirements for a comparatively brief period only and that the power available from these sites would probably be all required within three or four years. The amount of power available from the development of the other undeveloped sites already mentioned in this report is not very extensive and would probably show high unit costs of development. This brings up the question of the ultimate use of power in the district and of the source of supply for the not distant future. It would appear reasonable

that the extensions of the transmission system from Niagara to the eastward of Toronto would eventually prove economical for a number of places on the system, for example Oshawa, Whitby, Bowmanville and others. Another possibility for the future power supply for a considerable portion of the district is the projected development of the St. Lawrence River powers.

It is usually sound practice to use available power as close as possible to the generating point, having regard to comparative unit costs of development and the length of transmission lines required from other places. The question is therefore likely to arise in the near future of the policy of conserving all of the power sites on the System for use close to the developments and of linking up a portion of the System with transmitted power from Niagara or elsewhere. If this be done, certain municipalities now included in the System will be practically separated from it and the accounting should take into consideration the proper method of re-allocating the costs of the portion of the System so affected.

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Capital Costs.

General.

The figures of capital costs given in the table below and plotted diagrammatically and shown on the sheet of curves on page 26 were obtained from the figures of Exhibit I of the report of Messrs. Price, Waterhouse & Co. to the Hydro-Electric Inquiry Commission under date of October 26th, 1922, as far as these apply, namely, up to the fiscal year ending October 31st, 1921. The

figures for 1922 are based on the report of Mr. Clarkson entitled "Details of Plant Costs to September 30th, 1922", Hydro-Electric Inquiry Commission file 194a-2.

The figures show the total costs which are applicable only to the electric departments as a whole, in other words the costs of the various gas plants, waterworks plants, the Peterborough Radial Railway, the Campbellford Pulp Mill and the Bruton Township pulpwood areas have been deducted from the totals given in the above-mentioned reports. The costs of the Nipissing Section Electrical Department have also been eliminated from this table and are shown separately later.

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Table of Progressive Capital Costs of Electric Departments

Capital Assets (including intangible values)	As at March 1st, 1916	As at Year Ending October 31st, 1917	1918	1919
Developed Powers (Hydro-Electric)	$2,775,390	$2,785,638	$2,995,134	$3,104,144
Undeveloped Sites and Stand-by Plants	1,286,943	1,286,943	1,286,943	1,286,943
Power Development and Hydraulic Rights	4,062,333	4,072,581	4,282,077	4,391,087
Transformer Stations, Meter Stations, etc.	773,833	839,707	919,860	1,033,575
Transmission Lines	980,042	1,301,406	1,436,658	1,521,539
Local Electric Systems	798,662	883,500	915,018	946,136
Miscellaneous Capital, Tools, Supplies	186,000	320,000	412,000	412,000
Total	$6,800,870	$7,417,194	$7,965,613	$8,304,437

(Table continued on next page)

Table of Progressive Capital Costs of Electric Department - continued

Capital Assets (including intangible values)	As at Year Ending October 31st 1920	1921	1922
Developed Powers (Hydro-Electric)	$3,221,585	$3,779,032	$4,975,000
Undeveloped Sites and Stand-by Plants	1,286,943	1,286,944	860,000
Power Developments and Hydraulic Rights	4,508,528	5,065,976	5,835,000
Transformer Stations, Meter Stations, etc.	1,084,472	1,118,381	1,112,000
Transmission Lines	1,714,513	1,726,421	1,751,000
Local Electric Systems	1,058,525	1,128,821	1,213,742
Miscellaneous Capital, Tools, Supplies	435,000	500,000	510,000
Total	$8,301,078	$9,539,599	$10,421,742

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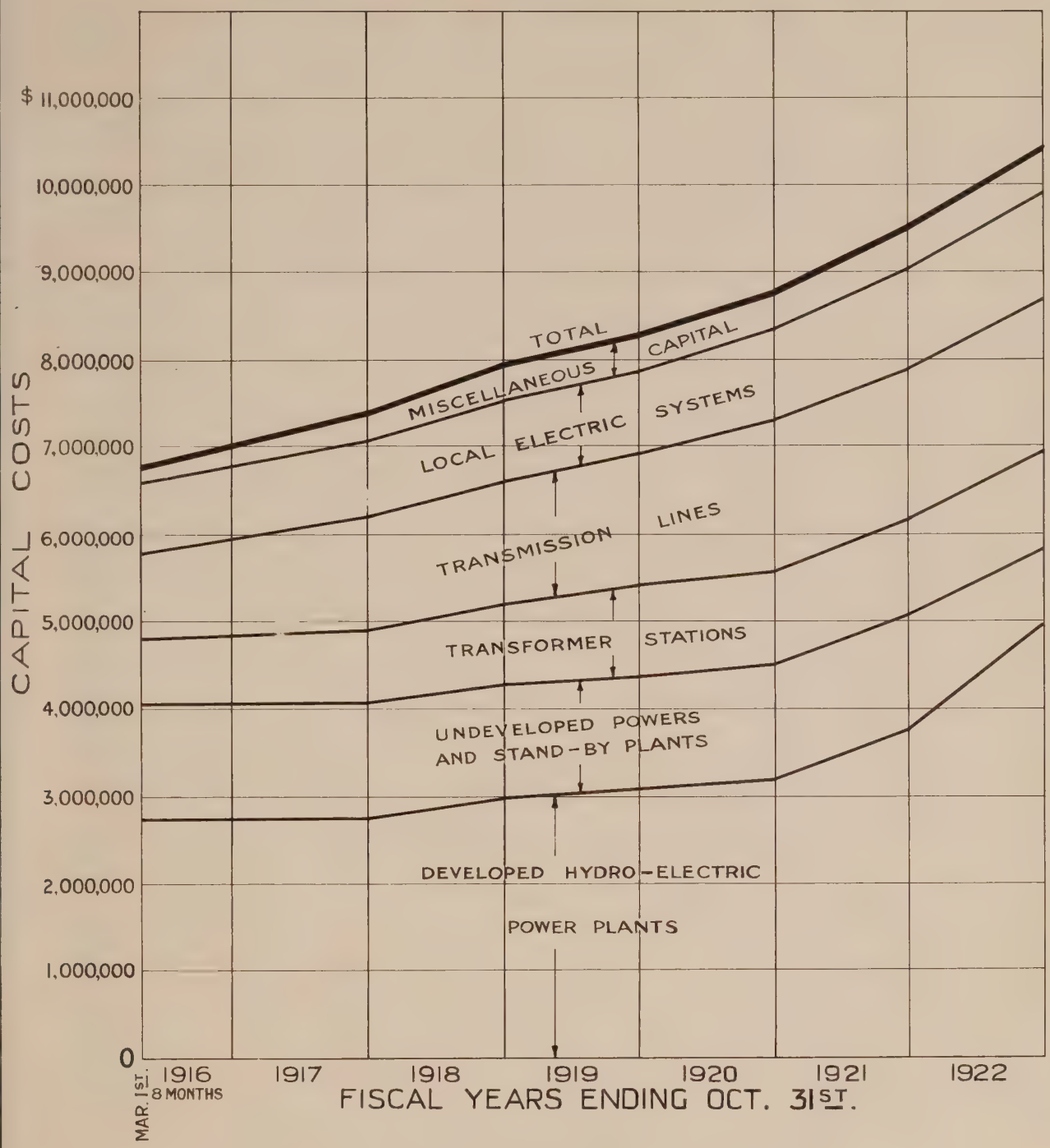
The sub-division of the third line of the table as between developed powers and undeveloped sites (lines 1 and 2) has been derived from the two above-mentioned documents wherever each would apply. Mr. Clarkson's report entitled "Analysis of Physical Assets as of March 1st, 1916", Hydro-Electric Inquiry Commission file 137a-2, dated September 4th, 1922, gives the total plant value $4,062,333 for March 1st, 1916, and by taking the respective sums of the applicable individual items this divides into $2,775,390 for developed plants and $1,286,943 for undeveloped powers and stand-by plants. Similarly, for the 1921 sub-division, the figures were derived from Exhibit I of Price, Waterhouse & Co. report, and Exhibit II of the same document, which gives the net increase in plant costs from 1916 to 1921 as $1,002,643 making allowance for the transfer of the Belleville Steam Plant to station account, thus



HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

PROGRESSIVE CAPITAL COSTS

Toronto, Jan. 5th, 1923. Made by SRH, Checked by RJH

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS

deriving the figure of $3,779,032.

The sub-division of the 1922 figures is taken direct from Mr. Clarkson's report "Details of Plant Cost September 30th, 1922" where the various individual items for stand-by plants and undeveloped sites amount to $860,000. The total for lines 1 and 2, from the Clarkson report, would make total plant costs of $5,534,761. In addition to this amount the expenditures on Ranney Falls plant for the balance of the fiscal year 1922 had to be added to bring the plant costs up to date. The total cost of Ranney Falls development is given in the report of Mr. Walter J. Francis, entitled "Principal Characteristics of H.E.P.C. Plants", as $1,695,300, or $302,000 more than Mr. Clarkson's figure to September 30th. The addition of this amount to Mr. Clarkson's total brings the total cost of the developed plants to $4,975,000 and the total of the two items together to $5,835,000 in round figures.

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As there were no entirely undeveloped sites which were partially or wholly developed for use on the system between 1916 and 1921, it has been assumed that the total book value of the undeveloped powers and stand-by plants remained unchanged between those dates and would only be reduced on the books as new sites are developed. For example, the book valuation of the Ranney Falls site would be included in the cost of developed powers for 1922 and deducted from the total value of the undeveloped sites. The same figure has therefore been used from 1916 to 1921 for the value of the undeveloped sites.

The fourth and fifth lines of the table, namely, transformer stations and transmission lines, have been taken directly from the above mentioned report of Messrs. Price, Waterhouse & Co. and need no comment. The figures for 1922 were

deriving the figure of $24,173,000.

obtained from Mr. Clarkson's report.

The sixth line of the table, headed "Local Electric Systems" was derived from the fourth line of Exhibit I in Price, Waterhouse & Co. report by subtracting from it the capital costs of all the gas plants, waterworks plants, and the Peterborough Railway.

The seventh line of the table, headed "Miscellaneous Capital Costs" was derived from Exhibit I of Price, Waterhouse & Co. report by adding the items "Tools and Equipment", "Rural Lines", "Materials and Supplies", these three being considered as applying directly to the electric systems as a whole. The sum of these items for each year was considered in its relation to the respective total capital of the Nipissing Section and the Central Ontario Section of the System, and it being found by inspection that the comparative capital investment of the Nipissing Section as compared with the Central Ontario Section was approximately in the proportion of one to sixteen, the total of the miscellaneous capital items above mentioned was therefore divided in this ratio and sixteen-seventeenths of the total applied to the Central Ontario Section.

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The Purchase Price of the Central Ontario System.

The amount agreed upon between the Ontario Government and the Electric Power Company, Limited, as the purchase price of the Central Ontario System was $8,350,000.00.

In 1914, the engineers of the Hydro-Electric Power Commission of Ontario had made a valuation of the assets of the System, and this was applied after the purchase had been made in order to sub-divide tangible from intangible

values. Based on the 1914 appraisal, the replacement values of the tangible properties, including additions to March 1st, 1916, were stated to be $5,487,659 for fixed capital, and $184,999 of material and supplies, leaving $2,677,342 as the amount considered as the value of the intangibles acquired in connection with the purchase of the System. The sub-division of these amounts as amongst the various properties concerned is as shown in the following table:

Table of Sub-division of Purchase Price

	Tangibles	Intangibles	Total
Central Ontario Section			
Developed Powers	$1,822,890	$952,500	$2,775,390
Undeveloped Sites and Stand-by Plants	323,731	963,212	1,286,943
Transformer Stations	632,406	141,428	773,832
Transmission Lines	804,060	175,962	980,042
Local Electric Utilities	637,992	160,670	798,662
Gas, Water and Street Railway	753,670	164,937	918,607
Pulp Mill	91,223	19,964	111,187
Nipissing Section			
Power Development and Steam Plants	229,011	62,151	291,162
Transformer Stations	25,072	5,842	30,914
Transmission Lines	35,136	8,186	43,322
Local Electric Utilities	118,937	22,492	141,429
Both Sections			
Materials and Supplies	184,999	-	184,999
Tools and Equipment	13,511	-	13,511
Total	$5,672,658	$2,677,342	$8,350,000

The allocation of the intangibles to the various portions of the System was apparently made on a more or less arbitrary basis for accounting purposes,

but it is understood that all intangibles are excluded in every instance in estimating property values upon which depreciation allowances are calculated.

Capital Costs of Ranney Falls Plant.

The Ranney Falls power plant situated at Dam No. 10 on the Trent River was built in 1920, 1921 and 1922. It has an average working head of fifty-four feet. The plant is rated by the Hydro-Electric Power Commission's engineers as having an output at 80 per cent. power factor of about 9,600 horse-power. Allowing for the difference between the available output in Summer and Winter, the plant has been rated for purposes of discussion in this report at 10,000 horse-power at 80 per cent. power factor.

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The total capital cost of the plant to October 31st, 1922, was stated by the engineers of the Hydro-Electric Power Commission to be $1,695,300.00, made up as follows:

Lands and water rights	$ 37,800
Dams and water structures	197,800
Power House	567,850
Equipment	666,850
Intangibles	225,000
Total	$1,695,300

The cost for dams and water structures given in this table does not include the cost of the Federal Government dams on the Trent River at this point, and to get a true measure of the total capital cost, this amount should be added to the above figures. There are also, it is understood, a few items of capital cost which have not yet been included in the above figures, but the exact amount of these has not been submitted at the present time.

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The amounts of money recorded in the various documents applying to the Ranney Falls plant are as follows. The Clarkson report on plant costs to September 30th, 1922, gives the valuation as at March 1st, 1916, $253,150, including intangibles, and which represents the book value of the undeveloped site, and states that additions made since that time to September 30th, 1922, amount to $1,139,582, or a total of $1,392,732.

The figures given in Price, Waterhouse & Co. report of October 26th, 1922, are as follows:

Spent to October 31st, 1919,	$ 1,586
Spent year ending October 31st, 1920,	107,473
Spent year ending October 31st, 1921,	565,245
Spent year ending August 31st, 1922,	553,497
Total	$1,227,801

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Adding to this figure the 1916 valuation of $253,150 the total cost to August 31st, 1922, becomes $1,480,951.

Appropriations for the project for the fiscal year ending October 31st, 1922, were $660,000.00, of which the Commission had received from the Province $50,000.00 to August 31st, 1922, and additional requisitions had been made amounting to $250,000.00 which had not been received up to August 31st, 1922. According to the figures submitted by the engineers of the Hydro-Electric Power Commission, approximately $215,000.00 of the above appropriations have been spent since August 31st, 1922, bringing the total up to the present stated figure of $1,695,300.00.

Assuming that there are to be no further capital expenditures on account of Ranney Falls, the capital cost is approximately $170.00 per rated horse-power exclusive of the cost of the dams built by the Federal Government.

A comparison of the costs of this plant with the others nearby on the Trent River reveals some interesting facts. The following table shows in brief form the relative capital cost per horse-power for each of the other six developed plants compared with Ranney Falls.

Table of Capital Costs per H.P. for Central Ontario Plants

	Head - Feet	Year Built	Horse Power Rating (H.E.P.C.)	Capital Cost per H.P. (H.E.P.C. Rating)	Capital Cost per H.P. based on Turbine Capacity	Remarks
Trenton	18.6	1911	4,000	$ 89.00	$ 64.00	Low head.
Frankford	17	1913	3,400	95.00	77.00	Low head.
Ranney Falls	54	1920-22	10,000	170.00	154.00	Elaborate design and high unit prices. Medium head.
Campbellford	22.5	1910	4,000	97.00	71.00	Low head.
Healey Falls	74	1913-14 and extended 1919	12,000	127.00	90.00	Turbine rating disproportionate to rated output. Medium head.
Auburn	17.5	1911-12	2,000	206.00	146.00	Cost of dam included, small capacity, low head, expensive local conditions.
Fenelon Falls	22.5	1899	930	244.00	227.00	Small capacity and expensive local conditions, low head.

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In the above table it should be noted that the rating of all of the plants is higher than the output which could be depended upon during the low water

season. Some consideration has evidently been given to an allowance for betterments in the present regulated flow of the waters, and also to spare capacity and to the usual commercial rating of plants of this nature.

For example, with a low water summer flow of 1,200 cubic feet per second at Ranney Falls, the electrical output would be about 6,400 horse-power, and the capital costs per horse-power of output would be about $265 instead of $154 based on the turbine capacity. Similarly the Trenton plant with a low water flow of 1,500 cubic feet per second would give about 2,800 horse-power output, and the capital cost on that basis would be $127 per horse-power, instead of $64 based on the turbine capacity.

The Ranney Falls plant was the only one constructed since the Ontario Government took over the System in 1916, with the exception of the extension to the Healey Falls plant in 1919. This extension consisted of the installation of one 4,000 horse-power unit at a total cost of $442,454, or approximately $110 per horse-power for the extension, but the larger part of this is chargeable to tail-race excavation and improvement for the whole plant. If the Ranney Falls plant had been constructed at pre-war prices the capital cost would doubtless have been greatly reduced. Judging by a comparison with prices elsewhere the cost would probably have been between $100 and $110 per turbine horse-power. From a comparison of conditions at the various sites, and making allowance for the difference in head and in the constructional features, and for the dates of construction, it may be stated that the Ranney Falls plant could have been built at a somewhat smaller cost per horse-power than was actually the case. The Ranney Falls plant has features of design which undoubtedly are more expensive

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in capital cost than at many of the other plants. The reinforced concrete penstocks, the elaborate reinforced scroll cases for the turbines, and the reinforced concrete draft tubes, together with a number of the electrical features have all been designed and constructed having in mind a very high grade construction and high efficiency in operating conditions. The policy of the engineers of the Hydro-Electric Power Commission apparently has been to develop this site for the maximum efficiency in operation and to place in the plant every feature making for absence of operating difficulties, and tending to long useful life.

The other plants on the system were all designed by a private company, and bear evidence of the fact that the designers had primarily in mind a return on the invested capital in the form of dividends, as well as giving a good service to the customers served.

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The above construction policy of the engineers of the Hydro-Electric Power Commission of Ontario seems also to have been applied in building the transformer stations and high tension transmission lines.

Power Data.

The table below and the diagram on page 36 have been prepared to show the number of horse-power in connection with the Central Ontario Section of the Central Ontario System.

Table of Horse-power Developed, Consumed, Billed, etc.

	Fiscal Years Ending					
	1917	1918	1919	1920	1921	1922
H.P. Developed	22,400	22,400	22,400	26,400	26,400	36,400
H.P. Developed plus Purchasable	23,800	23,800	23,800	27,800	29,400 27,800	39,400
H.P. Consumed, Average	11,553	14,710	11,620	12,965	14,095	14,515
H.P. Billed	-	-	22,719	26,098	29,950	31,460
H.P. Average of Twelve Monthly Peaks	19,520	24,050	20,450	24,200	25,300	27,550
H.P. Maximum Yearly Peak	21,600	26,000	24,500	28,000	28,300	33,500

It will be noted that there are six different classes of horse-power shown on the table and in the diagram. These may be explained as follows:

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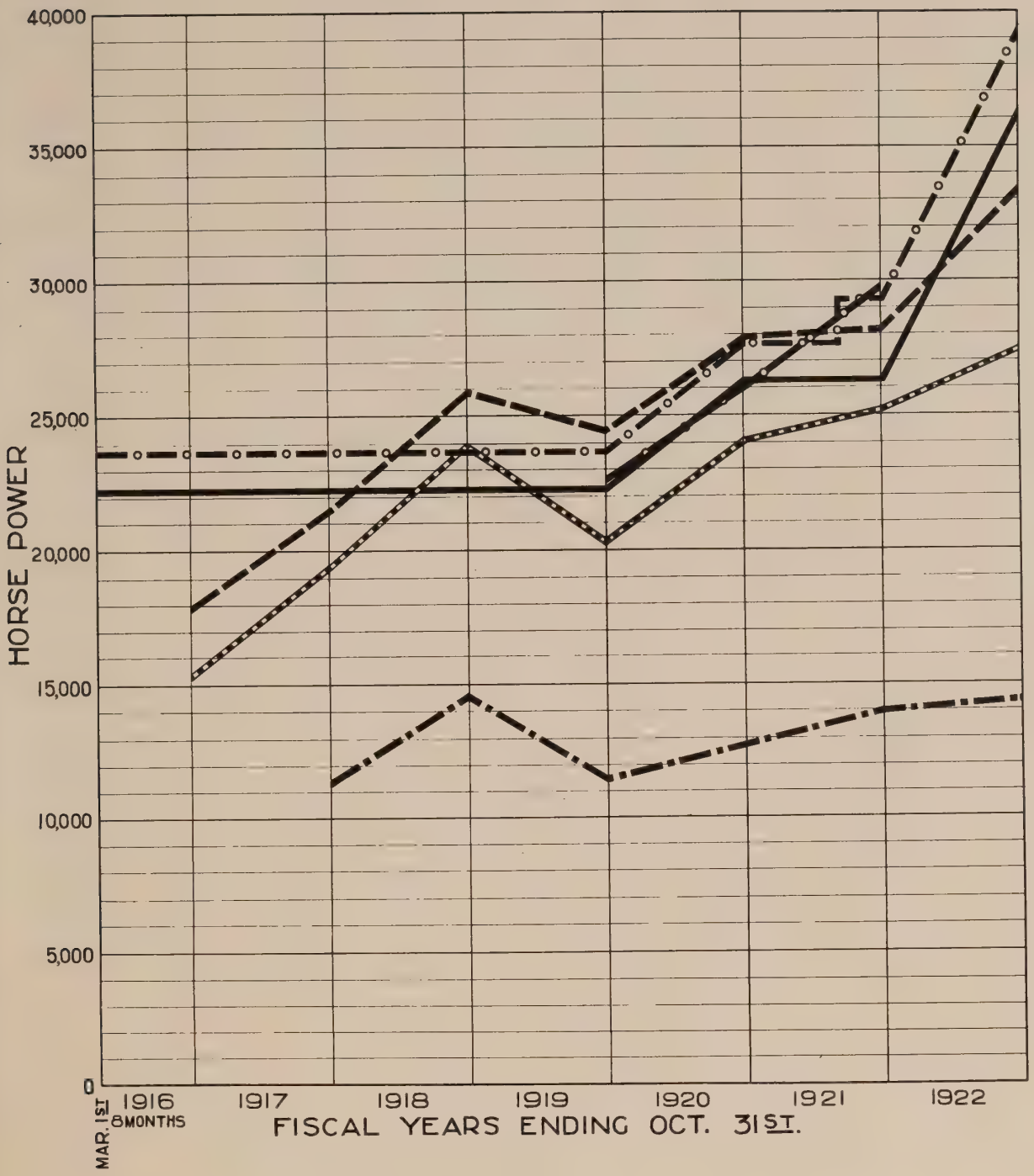
Developed Horse-power.

The data for plotting the curve showing the developed horse-power was obtained from the records of the Hydro-Electric Power Commission and is the sum of the rated capacities of all of the generating plants on this section of the System. The 1922 figures include the Ranney Falls plant as a whole and the capacity of this plant is shown as the average between Summer power and Winter power. The individual plant capacities at the present time are given in a letter from Mr. L. G. Ireland to Mr. H. E. Guilfoyle on November 11th. The rated capacity of the plants is expressed in horse-power at 80 per cent. power factor.



Maximum Yearly H.P. Peaks
Developed Plus Purchasable H.P.
Developed H.P.
Horse Power Billed Per Annum
Average of Monthly H.P. Generated Peaks
Average H.P. Consumed Per Annum

Hydro-Electric Inquiry Commission
W. D. Gregory, Chairman

Economics of H. E. P. C. Distribution Systems

Central Ontario System

Central Ontario Section

HORSE POWER DATA

Toronto, Jan. 5th., 1923, Made by W.D., Checked by L.H.

Walter J. Francis & Company
Consulting Engineers

Developed plus Purchasable Power.

This curve was prepared from the same data as the curve for developed power and includes in addition the available capacity of purchasable power from the plant of the Peterborough Hydraulic Power Company and the Campbellford Municipal Plant, the increments being added to the curve as they became available under arrangements made with the Hydro-Electric Power Commission.

Average Horse-power Consumed.

The average horse-power consumed has been derived from the total number of kilowatt hours given by the Hydro-Electric Power Commission as being the total consumption for this section of the Central Ontario System for each fiscal year ending October 31st from 1916 to 1922 inclusive. The derivation was made by dividing the total kilowatt hours per annum by 8,760, being the number of hours in a year, and reducing to horse-power by dividing by the factor 0.746.

COPY

Billed Horse-power.

The curve of billed horse-power was plotted from data given in Clarkson's report entitled "Detailed Operating Accounts for Each of the Four Years Ending 31st October, 1922", Hydro-Electric Inquiry Commission file 207a, dated November 20th, 1922.

Average Monthly Generated Peaks.

The curve of average monthly generated peaks was obtained by taking the average of the twelve monthly maximum generated peaks for each year as shown on the curve facing pages 82 and 83 of the 1921 report of the Hydro-Electric Power Commission, and dividing the sum of the monthly peaks by twelve to get a yearly average monthly peak. Each of these averages was then plotted as a single point for the average monthly generating peak for each year.

Maximum Yearly Peaks.

COPY

The curve showing the maximum yearly peaks was plotted directly from the maximum peak indicated for each year from the same source as used for the derivation of curve of average monthly generated peaks.

Capital Costs per Horse-power Developed

The diagram included as page 40 and the table below indicate the fractional capital costs per rated plant horse-power developed at different points of delivery, based on the sheet showing the capital costs of the combined electric departments, and the horse-power data given above. This sheet of curves therefore indicates the capital cost per rated plant horse-power with the spaces between each of the curves indicating that portion of the total delivered capital cost per horse-power chargeable against each of the items of the table, as follows:

Table of Capital Costs per Rated Plant Horse-power Developed

	1916	1917	1918	1919	1920	1921	1922
Developed Powers	123.95	124.30	133.50	138.58	122.10	143.14	136.80
Undeveloped Powers and Stand-by Plants	57.40	57.40	57.40	57.40	48.70	48.75	23.64
Transformer Stations, Meter Stations etc.	34.50	37.50	41.10	46.15	41.08	42.38	30.55
Transmission Lines	43.80	58.06	64.12	67.93	64.95	65.36	48.10
Local Electric Systems	35.60	39.45	40.85	42.24	40.10	42.77	33.30
Miscellaneous Capital, Tools, Supplies, etc.	8.30	14.30	18.40	18.40	16.48	18.94	14.10
Total	303.55	331.03	355.37	370.70	333.41	361.34	286.49

COPY

For example, at the end of 1922 the cost of the developed powers per rated plant horse-power is $136.80 while the cost of the undeveloped sites is $23.64 per rated plant horse-power, or a total of $160.44 per rated plant horse-power for the developed sites and the undeveloped sites and stand-by plants altogether. Similarly, the transformer stations now stand at $30.55 per rated plant horse-power on the Commission's books, transmission lines at $48.10 per rated plant horse-power, local electric systems at $33.30 per rated plant horse-power and miscellaneous capital costs at $14.10 per rated plant horse-power, making a grand total for the capital cost delivered to the consumer $286.49 per rated plant horse-power developed.

Total Revenues.

A table of figures giving the total revenues of the electric systems has

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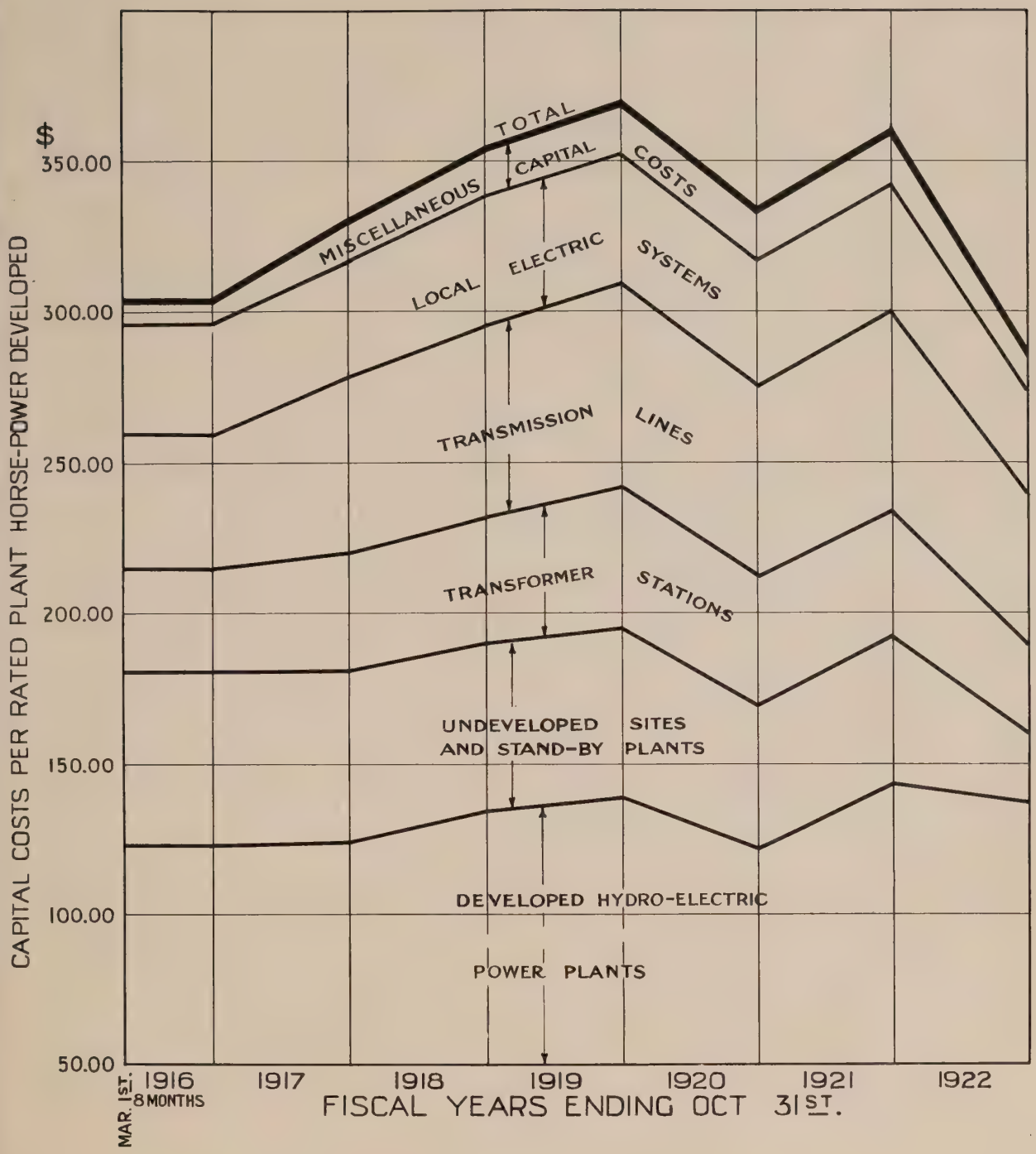

HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

CAPITAL COSTS PER H. P. DEVELOPED

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been prepared by using the figures of Exhibits VIII, VIIIa and IX of Price, Waterhouse & Co. report of October 26th, 1922, Hydro-Electric Inquiry Commission file 189a-2.

The tables of revenues have been combined for both the wholesale and retail departments and treated as if the whole of the power sales were handled by one division, as the retail sales department of this Section is essentially a portion of the power department.

The sub-division as between power sold at fixed rates to companies and other private consumers and that sold to municipalities at cost was obtained for the years 1919, 1920 and 1921 from Exhibit XIX of the above mentioned report, while the figures for 1922 were obtained from Clarkson's report entitled "Detailed Operating Accounts for Each of the Four Years Ending 31st October, 1922", Hydro-Electric Inquiry Commission file 207a, dated November 20th, 1922. The figures for 1917 and 1918 are given combined for these two items and the sub-division for these two years was estimated from a comparison of the usage by the principal customers in the different years.

COPY

The sales of power to the Cobourg Waterworks, Peterborough Radial Railway, the Campbellford Pulp Mill and the Trenton Waterworks have been considered on the same basis as power sold to municipalities at cost where such municipalities distribute on their own behalf and the distribution is not done by the Hydro-Electric Power Commission. In other words, these four consumers are considered as being similar to such municipalities as Peterborough, for example for revenue purposes. Certain adjustments for power sold at cost to some of the municipalities have been added to the revenues for the years 1918, 1919 and 1920 in

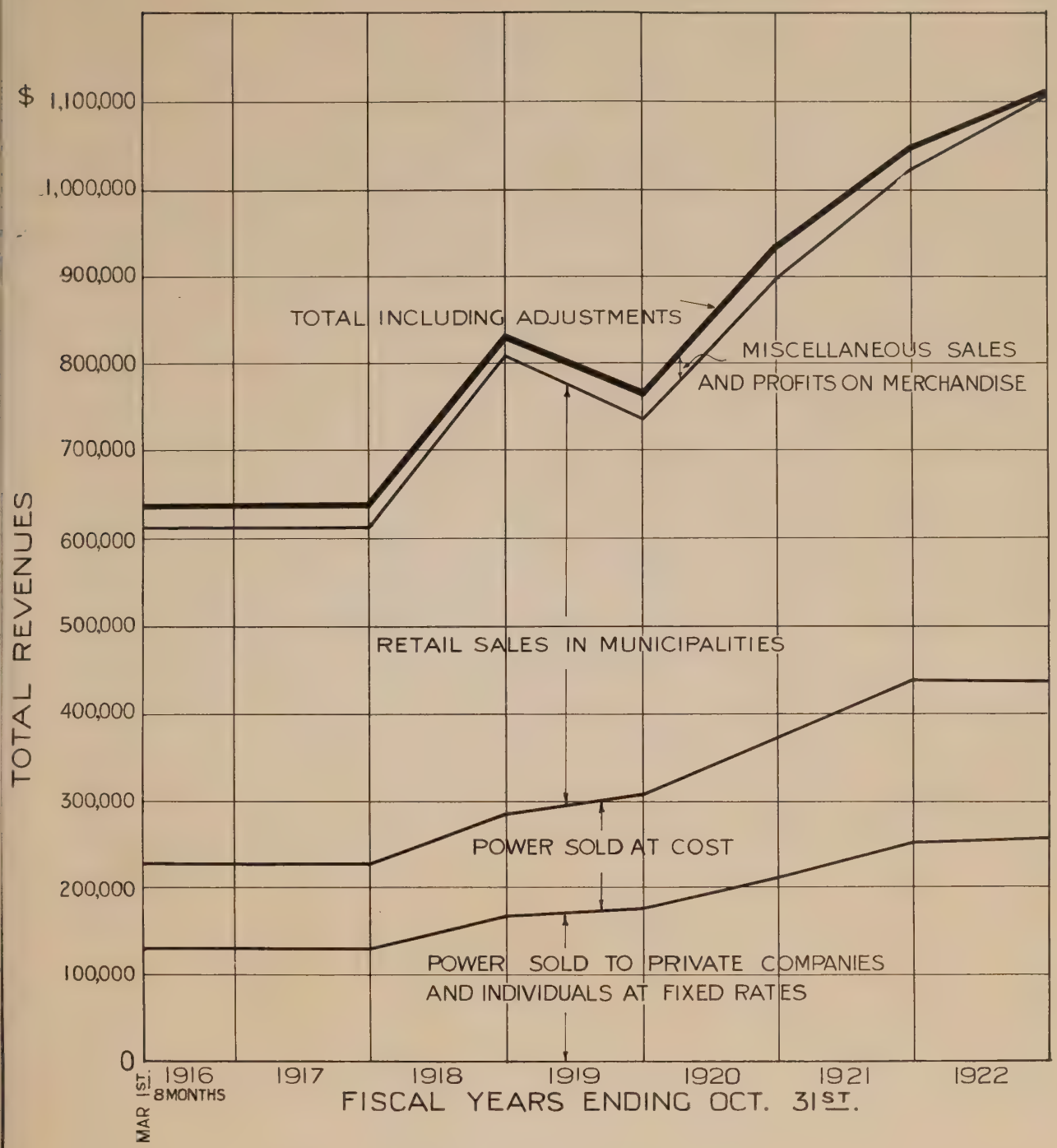
accordance with the figures shown on Exhibit VII of Price, Waterhouse & Co. report.

The revenue from retail customers is that shown on the first line of Exhibit XI of Price, Waterhouse & Co. report each year from 1916 to 1921, while the 1922 figures are from the Clarkson report. For the period from March 1st, 1916, to October 31st, 1917, the figure given in Exhibit VIII as the revenue derived from the retail department by the power department is $301.276, while Exhibit IX gives $312,850, as the cost of power from the power department to the retail department. The difference, namely, $11,574, represents the operating costs of sub-stations and for the purposes of this study has been added to the operating costs given in Exhibit IX. This is the only year in which any discrepancy in this figure occurs. To obtain an approximate comparison for each yearly period, six-tenths of the total figures for the twenty months from March 1st, 1916, to October 31st, 1917, have been taken as being applicable to the twelve months ending October 31st, 1917. This is not exactly correct, but is sufficiently accurate to indicate yearly comparisons for the purposes of this report.

COPY

The other items of revenue, namely, miscellaneous sales of the power department and the profit on merchandise sold by the retail department in various municipalities has been added to the direct revenue from the sales of electricity and shown as miscellaneous revenue.

The four main groups of revenue have been plotted as a series of curves shown on page 43 under the following heads, namely: (a), power sold to private companies, and to individuals at fixed rates; (b), power sold at cost to



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W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

TOTAL ANNUAL REVENUES

Toronto, Jan. 5th., 1923, Made by SRW, Checked by L.H.

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certain municipalities and to gasworks, waterworks, railway and pulp mill; (c), retail sales in municipalities where power is distributed direct by the Hydro-Electric Power Commission; and, (d), miscellaneous sales and profits on merchandise.

The figures from which the above mentioned curves were plotted are as follows:

Table of Total Revenues for Various Classes of Customers

	1917 (Approximate)	1918	1919	1920	1921	1922 (Approximate)
(a) Power Sold to Companies and Private Consumers	$132,000	$170,000	$178,651	$213,624	$252,230	$257,780
(b) Power Sold to Municipalities at cost	61,266	74,084	76,145	93,202	142,252	148,441
Cobourg Water Works	2,100	525	-	-	-	-
Trenton Water Works	411	-	-	-	-	-
Peterborough Railway	-	6,000	6,296	6,695	16,186	16,186
Pulp Mill	33,340	36,183	39,099	39,244	28,866	15,879
Adjustments	-	2,232	27,004	20,764	-	-
Total for this Classification	97,117	119,024	148,544	159,905	187,304	180,506
(c) Power Sold to Retail Consumers	385,025	520,137	408,197	525,098	582,650	668,537
(d) Miscellaneous Sales	6,470	2,380	3,549	3,396	4,041	1,785
Profits on Merchandise	17,048	19,215	24,988	33,624	22,833	-
Grand Totals	637,660	830,756	763,929	935,547	1,049,058	1,108,608

COPY

Total Costs of Power.

The table on page 47 shows the costs of power sub-divided under various headings for each of the years from 1917 to 1922 inclusive. These costs include the totals for both the wholesale and retail departments as if they were operating as one system. The figures from 1917 to 1921 inclusive are made up from Exhibits VIII, VIIIa and IX of the Price, Waterhouse & Co. report dated October 26th, 1922, while the figures for 1922 are derived from the Clarkson report, Hydro-Electric Inquiry Commission file 207a.

It was found impracticable to sub-divide the costs as between the various classes of revenue producers; therefore, a system of sub-division was adopted which would indicate broadly the main items of expense in connection with the production of power considered as a whole. The headings under which the various costs have been grouped are as follows:

COPY

Operating Costs.

Operating costs include the wages of power house operators, linemen, station attendants and so forth, power purchased from other companies, supplies and all the miscellaneous items usually grouped under this item, and also water rentals payable to the Dominion Government and adjustments thereof year by year, as shown on Exhibit VII of the Price, Waterhouse & Co. report.

Maintenance.

Under maintenance have been placed all the items for labour and materials

charged in the books of the Commission as against the individual portions of the plants, stations, lines and distribution stations and these have been grouped together, from the individual figures in the Price, Waterhouse & Co. report, to make one item.

Overhead and General Expense.

Under the heading of overhead and general expense are such items as salaries of local officers and clerks, printing and stationery, stores operation, taxes, insurance, rents, legal expense, miscellaneous office supplies and so forth, all in accordance with the Price, Waterhouse & Co. figures for the various items.

COPY

Interest.

The figures for interest include all interest charges for the power department and the retail department based on the capital allocated to each branch, all as given on Exhibits VIII and IX of the Price, Waterhouse & Co. report.

Renewals.

The renewal account includes all items shown as chargeable against renewals in the same Exhibits and is given as one total for the whole electric department of the Central Ontario Section.

Contingencies.

The figures for contingencies have been transferred directly from the above Exhibits.

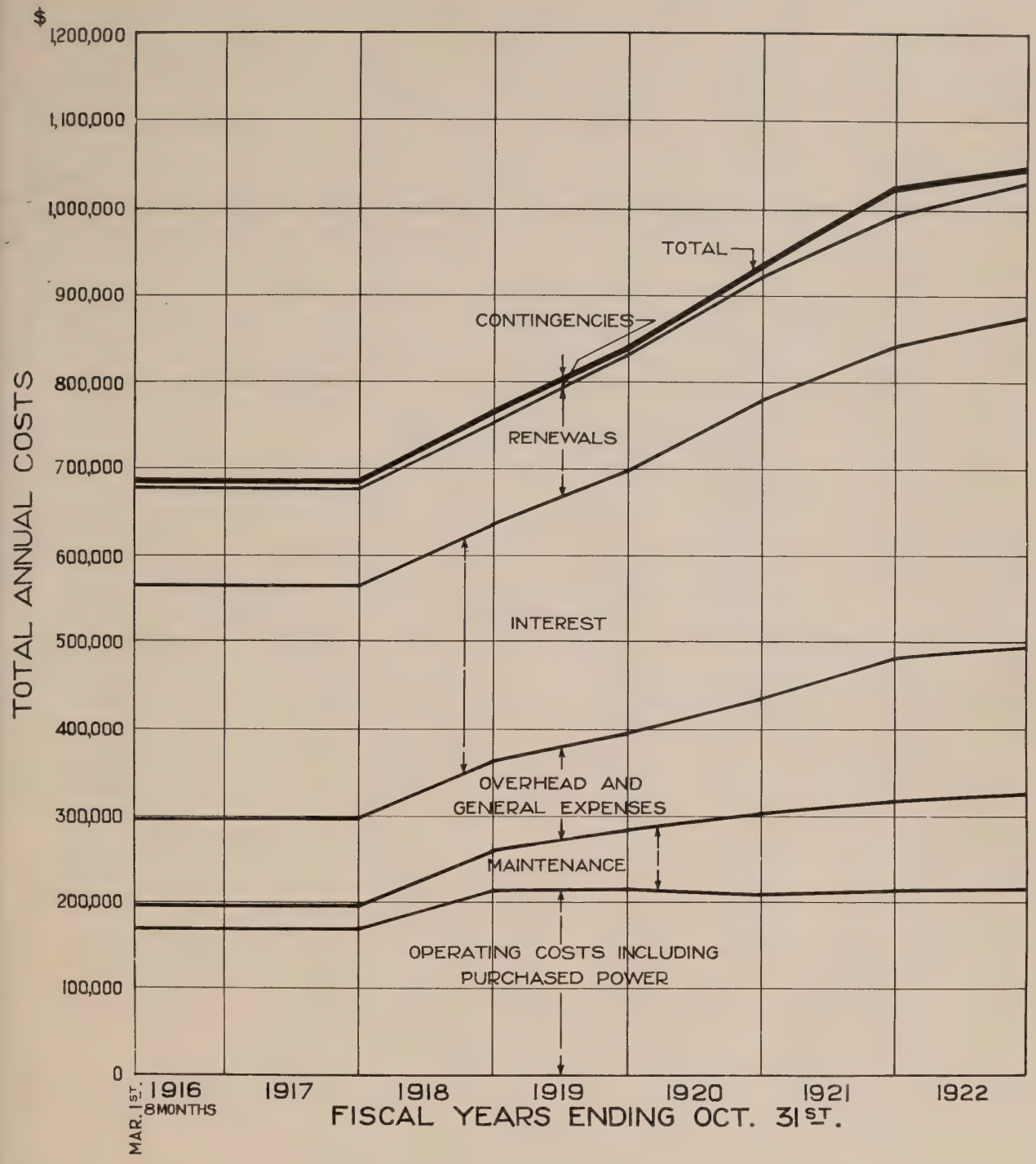
As before, the yearly totals for 1917 have been approximated as six-tenths of the total of the twenty months' period from March 1st, 1916, to October 31st, 1917.

The sheet of curves on page 48 is the direct plotting of the figures in the table below with the spaces between each of the curves indicating the amount chargeable against that particular item. For example, in 1921 the space between the lowest curve and the base line is $213,157, while the distance between this point and the next curve immediately above it represents a charge of $105,371 against maintenance, making the total cost, for maintenance and operating cost together, $318,528. Similarly overhead and general expense for 1921 is indicated by the distance between the maintenance curve and the third curve from the base line, and so on. The figures are as follows:

COPY

Table of Total Yearly Costs of Power

	1917	1918	1919	1920	1921	1922
Power Purchased & Operating Costs	$169,568	$215,442	$215,126	$210,677	$213,157	$216,633
Maintenance	27,900	46,648	70,401	91,646	105,371	110,000
Overhead & General Expenses	101,000	101,094	110,721	134,966	163,622	165,812
Interest	268,000	274,162	304,280	344,105	362,379	381,715
Renewals	112,000	119,604	132,444	143,649	151,839	161,548
Contingencies	3,470	6,835	5,620	5,510	27,204	7,648
Totals	$681,938	763,785	839,602	931,553	1,023,572	1,043,356



HYDRO-ELECTRIC INQUIRY COMMISSION
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ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

TOTAL ANNUAL COSTS

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Percentage Costs of Power.

The sheet of curves included as page 51 shows the above figures plotted as percentages of the total costs of power per annum, and is included as a method of comparison with other systems or similar properties.

Analysis of Reserve Accounts.

Renewals Account.

On page 52 is shown a series of curves which indicate graphically the relation between that portion of the properties subject to physical deterioration in the electrical departments and the reserve fund for renewals which has been accumulated up to the present time. It is understood that it is the practice of the Hydro-Electric Power Commission to spend sufficient money on maintenance account each year so as to keep each and every portion of the System in a condition to operate in accordance with the requirements of economical production, which it is stated is considered to be about seventy-five per cent. as good as its original new condition. This being so, it was considered that the renewal accounts should be studied in connection with and applied to the renewal of only twenty-five per cent. of the capital concerned.

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The methods indicated in Exhibits V, VI, VIa, and VIb of the Price, Waterhouse & Co. report for setting aside a percentage of the depreciable capital each year on a sinking fund basis are quite usual and are considered standard practice. Briefly stated the method is as follows:

COPY

The useful life in years of each portion of the depreciable capital investment is estimated, the replacement cost and the residual or scrap value of the articles at the end of this time are also estimated and an amount is set aside which when compounded at an assumed earning rate will retire the total amount to be provided for at the end of its own particular useful life. Similar items are then grouped and an average figure found which will apply to the whole. It is stated in the Price, Waterhouse & Co. report that the rate of 2.5 per cent. of the depreciable capital has been fixed on a sinking fund basis as a reserve for renewals in respect of a certain capital investment in power development, lines and stations. An average rate of 2.5 per cent. invested and compounded at the earning rate of 4 per cent. as assumed would retire this amount of capital in about twenty-four years, which is apparently the average life given to this portion of the depreciable capital for the Section. An examination of Exhibits V, VI, VIa and VIb indicates that most of the parts of the Section as considered in 1916 had been in service since the period 1910 to 1912. This indicates a weighted average use up to the present time of about twelve years.

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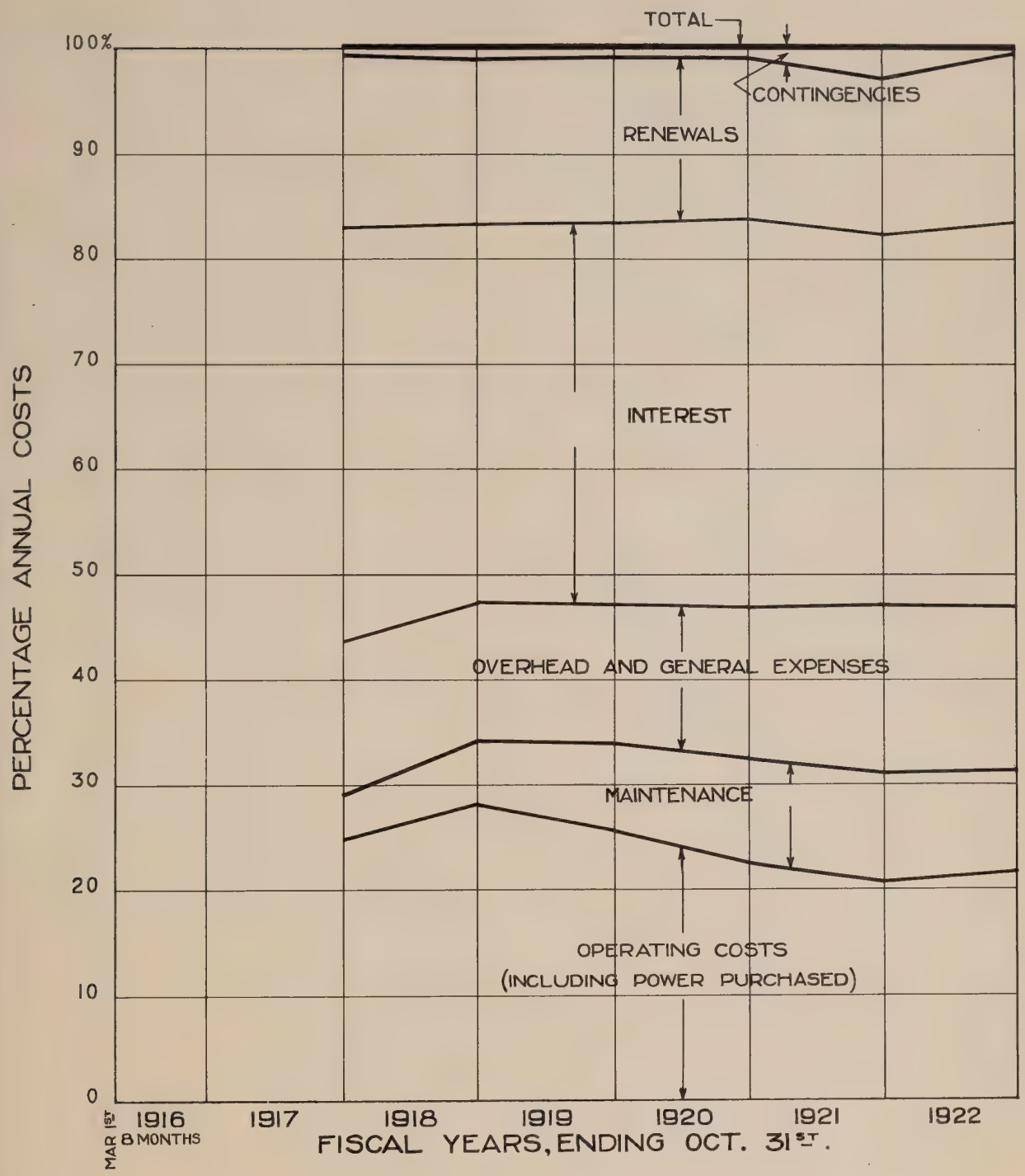
The capital cost for certain specified plants and lines in 1916 for which depreciation is calculated is given in the report at $3,317,689. The total capital investment in the electric departments at that time was $6,800,870, leaving $3,483,181 on which no depreciation allowance seems to have been made. As about $2,400,000 of this is chargeable against the electric departments as "intangibles" for which a renewal fund might be omitted, there remains an amount of about $1,000,000 which has not been provided for. This is apparently



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ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

ANNUAL COSTS SUBDIVIDED BY PERCENTAGES

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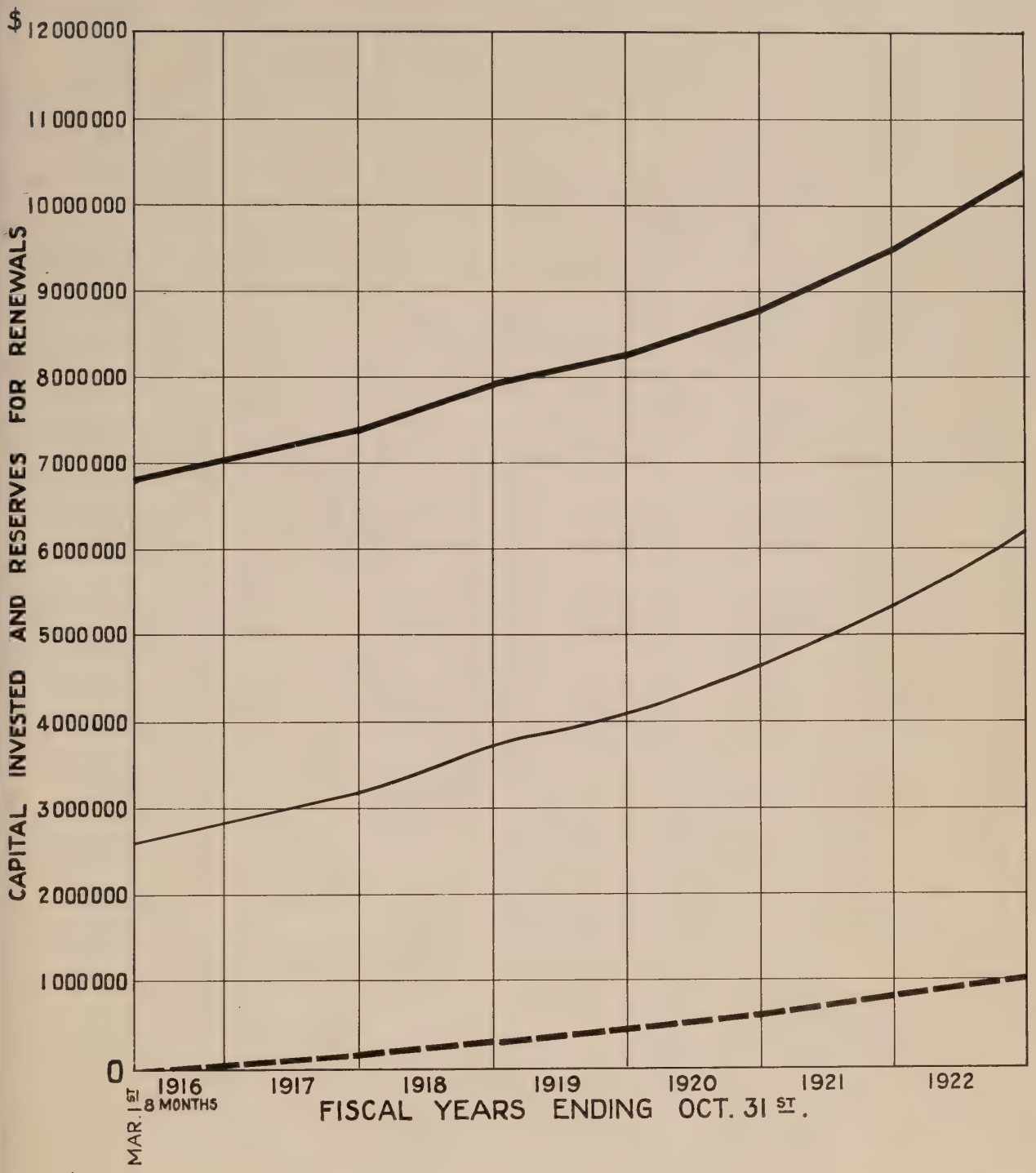

TOTAL INVESTED CAPITAL, ELECTRIC DEPARTMENTS. SHOWN THUS. ———

TOTAL DEPRECIABLE INVESTED CAPITAL, POWER DEPARTMENTS. SHOWN THUS. ———

TOTAL RENEWAL RESERVES, ELECTRIC DEPARTMENTS, INCLUDING INTEREST. SHOWN THUS. — — —

HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

RESERVES FOR RENEWALS, ELECTRIC DEPARTMENTS

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the depreciable part of the local distribution systems. Since 1916 additional investments have been made in the electric system to the extent of approximately $3,621,000. Of this $1,695,300 is chargeable to Ranney Falls and about $1,470,000 of this last figure represents tangible assets. The Ranney Falls plant commenced service in 1922, so that there has been no need for depreciation allowance on this amount up to the present time. Based on the above figures, the total depreciable capital upon which renewal funds should be calculated at the present time is therefore approximately $7,250,000 including Ranney Falls, or about $5,750,000 exclusive of Ranney Falls.

Taking into consideration the average period of service for this amount of capital and its estimated useful life, and allowing for the upkeep of the plants to about seventy-five per cent. of their original efficiency by means of the annual maintenance charges, it would appear that the total renewal fund to be provided for at the end of the useful life of this portion of the investment is approximately $1,800,000 including Ranney Falls, or approximately $1,440,000 exclusive of Ranney Falls. Inasmuch as the useful life of the electric system, without Ranney Falls, is probably less than one-half over, and the Ranney Falls plant has only now commenced to operate, and that there is a renewal account on the books of something over $1,000,000 applicable to the electric system, it would appear that the accumulated renewal fund is large enough to replace the whole of that portion of the electric system which would eventually require renewal, when the fund is augmented from year to year by the proper allowances compounded in the usual way.

During the past few months the various heads of departments of the

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Hydro-Electric Power Commission of Ontario have been carefully studying the question of depreciation rates and the proper allowance for useful length of life for each kind of equipment and they have come to the conclusion that the rates formerly allowed have been too high; in other words the actual deterioration of the various parts of the system has not been as great as was expected and they have prepared figures to show that their former practice was too conservative in allowing for estimated useful life. They have, therefore, suggested that the renewal allowances on the sinking fund basis be considerably reduced in the annual charges. This would have the effect of building up the reserve fund in future at a slower rate, and of correspondingly reducing the annual costs, and consequently reducing the total annual cost of power.

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There are one or two points which should receive careful consideration in dealing with the question of these reserves for renewals. One is the proposed change in the estimated length of useful life of the various portions of the equipment, which will materially affect the annual allowances, and the other is the question of the proper rate of interest to be chosen in estimating the earning power of the invested reserve funds.

A strict theory of the earning power of the renewal fund would take into consideration not only the method of investing the fund, for example, whether it be used in making extensions and betterments in the System as has actually been done, or invested in separate securities and treated like a trust fund, but also the rate of annual interest, which should be adjusted each year in accordance with the actual value of money. The legal limitations of the allowable investment of the fund should also be kept in mind in this connection.

Sinking Funds.

The study of the finances of the System show that a comparatively small amount is being set aside as sinking fund to provide for the financial obligations concerning any of the properties. The Oshawa rural lines, the Bruton Township pulpwood areas, and the Bancroft mill have sinking funds directly applied against them. The total capital invested in these properties is about $418,761 while the total accumulation of the sinking fund to October 31st, 1921, amounts to $28,666. Apparently these sinking funds are being set aside on a basis to retire the capital in thirty years with earning power for the sinking fund at four per cent.

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Because the System was purchased with 10-year bonds of the Province to mature in 1926 and no sinking fund has been set aside to retire these bonds, it is too late at this stage of operation to set aside any sinking fund which would retire the bond issue within the next three years or four years. The question of re-financing the Central Ontario System will undoubtedly have to be carefully considered in the near future, and at that time the whole question of the provision of a sinking fund to retire the new bond issue, or other method of financing, should be considered. It would appear to be good practice to provide such a fund.

Reserve for Contingencies.

The study of the accounts of the System leads to the conclusion that the reserve for contingencies is probably too small.

The power department has been apparently setting aside a reserve for contingencies on the basis of 25¢ per horse-power installed, except in 1921 when an additional amount of $19,000 was provided for the purpose of meeting extraordinary losses at Healey Falls. The total of the reserve to the end of October, 1921, amounted to approximately $54,232. Charges against this reserve account up to the same period amounted to $46,279, leaving a balance at that time of $7,953. Of the total expenditure, over $30,000 was made on account of damages to the Healey Falls plant by flood and fire in 1921. Having in mind the heavy losses which might be occasioned through catastrophe, it is therefore felt that the total amount at the credit of this fund should be augmented by increasing the annual allowances for contingencies, and when a reserve of say $50,000 or $75,000 will have been built up the rates can be readjusted to suit the conditions found after several further years of experience.

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Discussion of Deficits and Surpluses of Various Departments of the Section.

The five sheets of curves included as pages 59, 61, 63, 65 and 67 show in graphic form the separate analyses of the accumulated surpluses or deficits of each of the main divisions of the Central Ontario Section of the Central Ontario System, namely:

(a) The Electrical Departments
(b) The Gas Plants
(c) The Waterworks
(d) The Peterborough Railway
(e) The Pulp Mill

The figures from which these curves were plotted are given in Exhibit VII of

the Price, Waterhouse & Co. report. The figures for 1922 are taken from Clarkson's report "Detailed Operating Accounts for Each of the Four Years Ending 31st October, 1922", Hydro-Electric Inquiry Commission file 207a, dated November 20th, 1922.

Electrical Departments.

The curves on page 59 indicate the result of operations for the wholesale and retail electric departments considered as a whole. Under the present system of book-keeping, the retail department, namely, those municipalities in which power is distributed by the Hydro-Electric Power Commission, purchases power from the power department and charges that item as an operating cost, whereas the power department credits the same amount as a revenue for the power department. In the curves shown the profits and losses of these two departments have been plotted separately to indicate the result of the present system of book-keeping, whereby the retail department shows a consistent profit and the power department shows a consistent loss. As the intention of the Hydro-Electric Power Commission is to supply power to consumers at actual cost, an inspection of these curves indicates that a readjustment of rates as between the power department and the retail department should be made if the book-keeping is to be continued on a separate basis, especially as a number of those municipalities where the Hydro-Electric Power Commission is now distributing to the customers by retail methods have the option of purchasing their distribution system from the Commission and operating it themselves in a similar manner to those municipalities, such as Peterborough, which purchase wholesale power at

COPY

cost from the Commission and do as they wish with it afterwards.

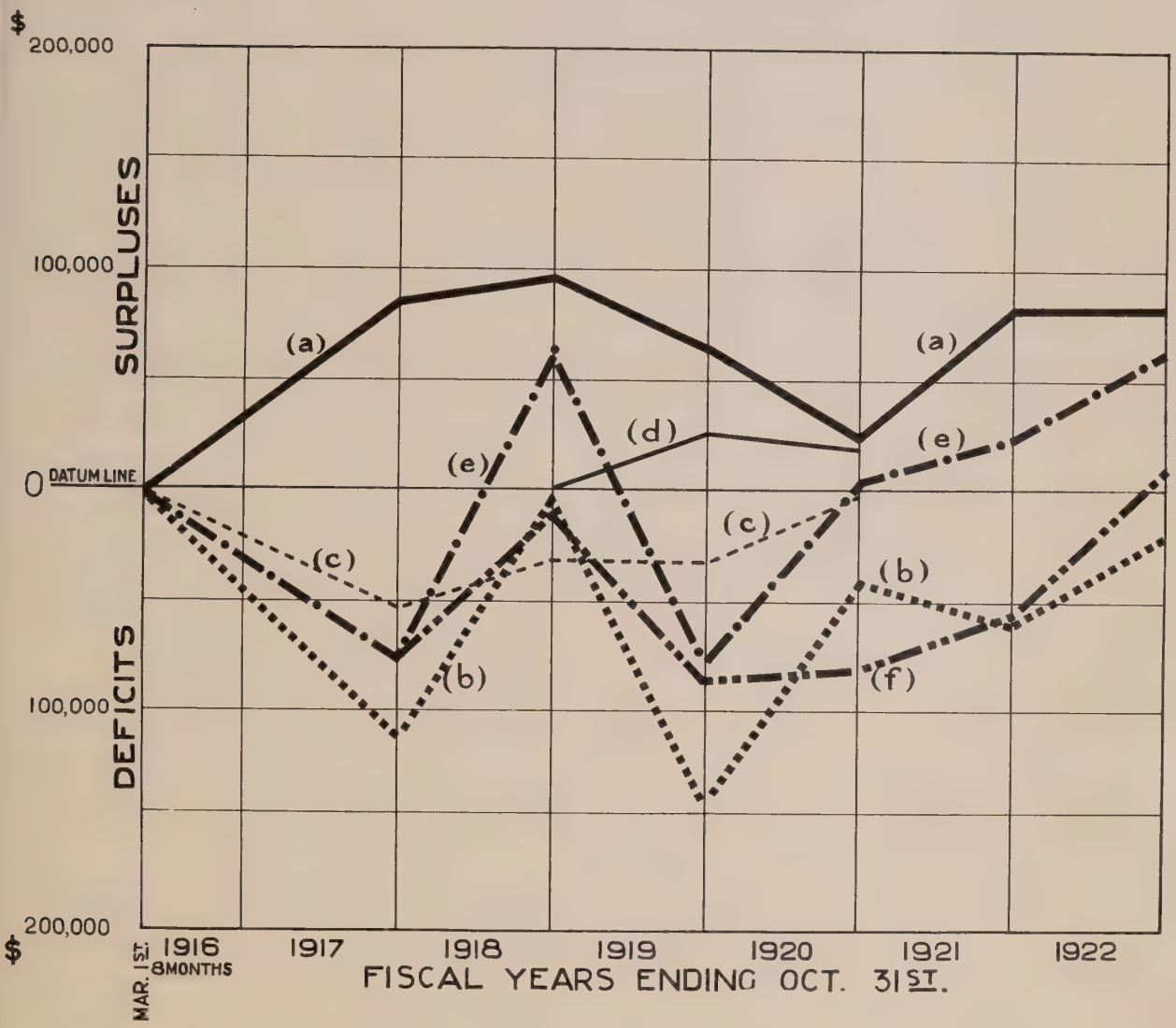
Included in the set of curves on the following page are certain adjustments for water rentals which should have been paid to the Department of Railways and Canals, Canada, in the years 1916, 1917, 1918, 1919 and 1920, and there has also been plotted an allowance for power revenue to the power department which should have been paid by certain municipalities which were supposed to pay actual cost for their power but did not do so until the figures for 1918, 1919 and 1920 were adjusted. The four component curves on this page are therefore as follows:

(a) Local electric systems, retail distribution.
(b) Power department, wholesale distribution.
(c) Additional water rentals payable.
(d) Power adjustments to be credited.

COPY

The annual summation of these four curves is indicated by curve "e" which shows the annual surplus or deficit of the combination of the two systems. An examination of this curve shows that at the end of 1917 there was a deficit of approximately $73,000 from the operation of the combined systems, a surplus of approximately $64,000 for the year ending October 31st, 1918, a deficit of approximately $76,000 for the year ending October 31st, 1919, a surplus of about $5,000 for the year ending October 31st, 1920, a surplus of about $25,000 for the year ending October 31st, 1921, and a surplus of about $65,000 for the year ending October 31st, 1922.

Curve "f" shows the accumulated result of these various annual totals and indicates that at the present time all individual annual deficits have been offset by the sum of the individual annual surpluses and there is now an accumulated surplus for the combined electric systems of the Central Ontario Section of



LOCAL ELECTRIC SYSTEMS
POWER ADJUSTMENTS
WATER RENTALS
COMBINED ANNUAL RESULTANT
ACCUMULATED DEFICITS OR SURPLUSES
POWER DEPARTMENT

HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

ANNUAL & ACCUMULATED DEFICITS AND SURPLUSES, ELECTRIC DEPARTMENTS

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the Central Ontario System of approximately $10,000. This surplus indicates that the electric departments have paid all operating costs and fixed charges under the various headings already listed and have at their credit $1,012,000 for renewal fund as well as $10,000 of surplus.

The Gas Plants.

The curves plotted on the diagram included as page 61 indicate the combined result of operations for the four gasworks in Cobourg, Napanee, Oshawa and Peterborough for the period commencing March 1st, 1916, and ending October 31st, 1922. The figures for 1916 to 1921 inclusive are from the figures of Exhibit VII of Price, Waterhouse & Co. report, the details of which are to be found in Exhibit X of the same document. The 1922 figures are taken from the above-mentioned Clarkson report.

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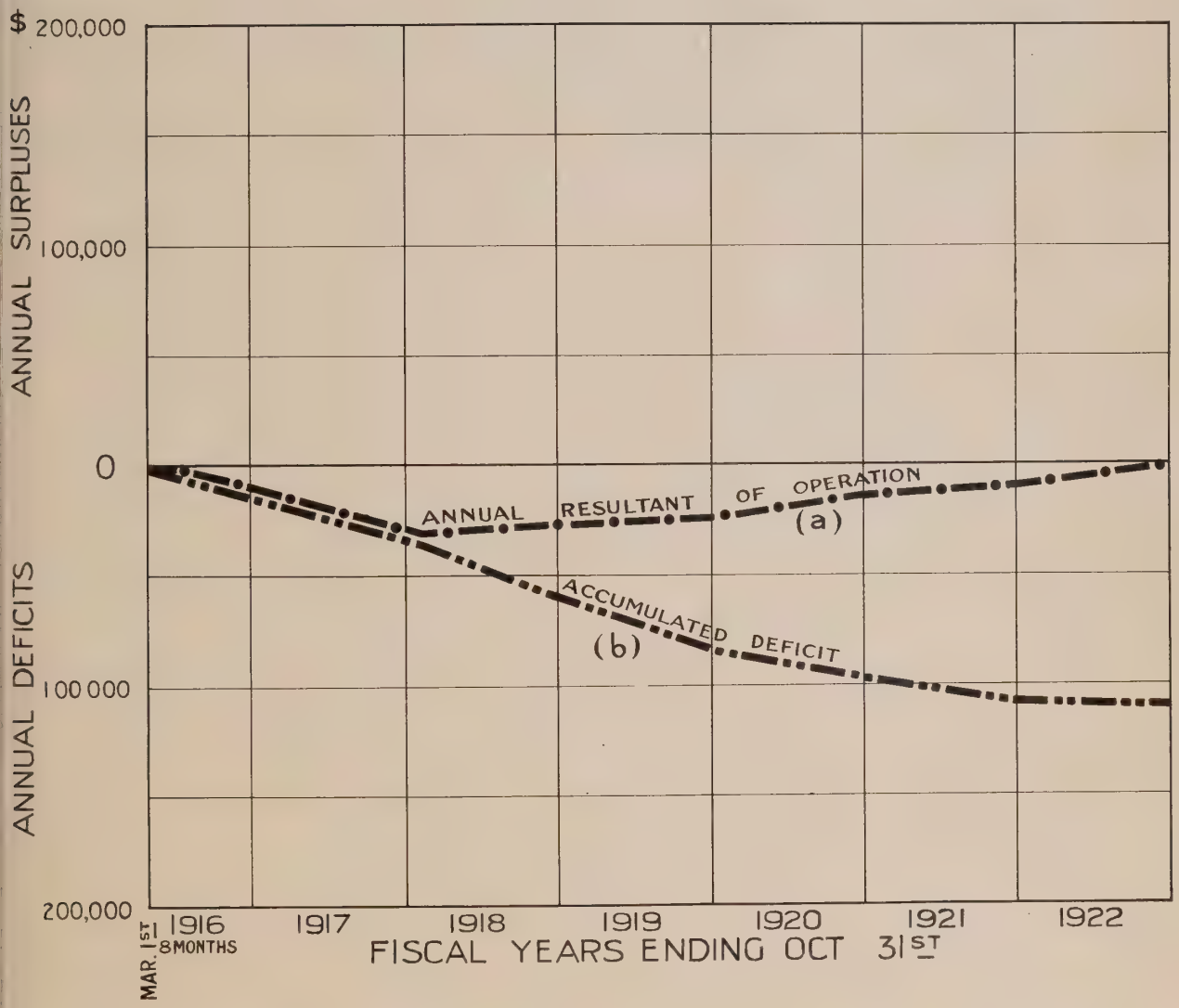
Curve "a" indicates the annual deficits for the combined operation of the four plants. This curve shows that when the plants were taken over for operation by the Hydro-Electric Power Commission they were losing a considerable amount as the result of operation. An examination of the capital account of these plants shows that a considerable sum of money was spent in betterment of the plants and that this, combined with changes in operating methods and rates, has lessened the annual deficit year by year until at the present time the plants are rapidly approaching a point where the revenues will be equal to the total costs, in other words, the annual deficit is becoming less and less.

Curve "b" shows the accumulated deficits. It will be noted that the shape



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ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

ANNUAL & ACCUMULATED DEFICITS AND SURPLUSES, GASWORKS

Toronto, Jan. 5th. 1923, Made by SRW, Checked by L.A.

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of this curve is becoming very flat, indicating that a point will soon be reached where it should commence to turn upwards and should reach the zero line within a reasonable time provided no radical changes in capital costs or operating conditions are encountered. Increased rates and unchanged operating costs would bring the accumulated deficit curve back to zero more quickly, while unchanged rates for gas and increased operating costs would defer the attainment of this result.

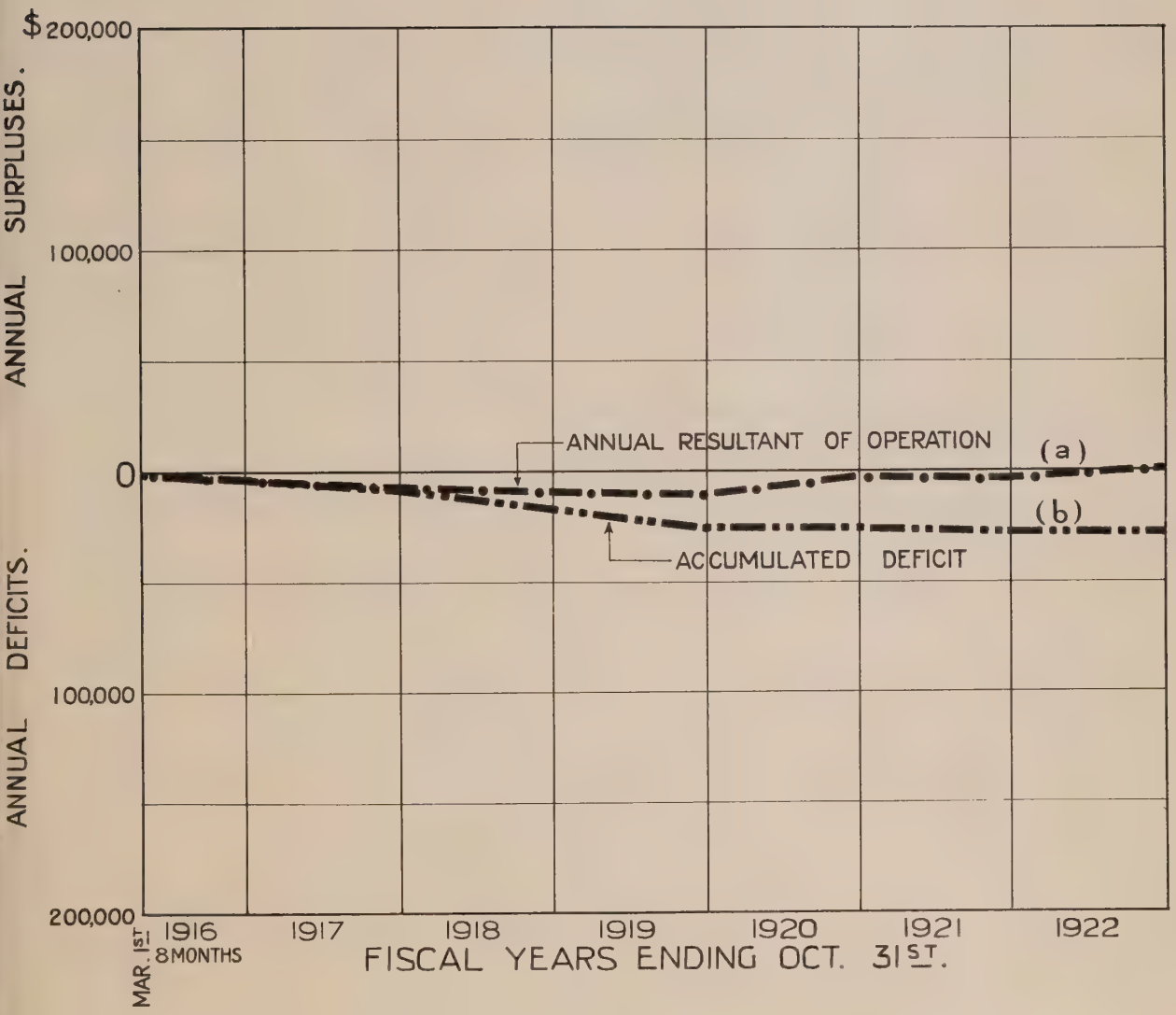
The Waterworks.

The records show that the Central Ontario Section of the Central Ontario System originally had included in it two waterworks, one at Trenton and one at Cobourg. The Trenton waterworks was sold to the town of Trenton at slightly less than the figure at which it was carried on the Commission's books. As no useful purpose would seem to be served by a further discussion regarding this plant, no further comment will be made upon it.

COPY

The Cobourg waterworks is still being operated by the Commission and the curves on page 65 indicate the result of operations to date. The figures for the deficits and surpluses for 1916 and 1921 inclusive were taken from Exhibit VII of the Price, Waterhouse & Co. report and the details are given on Exhibit XI of the same document. The figures for 1922 are taken from the Clarkson report.

Curve "a" shows the annual deficits and surpluses and indicates that since 1920 the Cobourg waterworks has been operated at practically no loss and that



HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

ANNUAL & ACCUMULATED DEFICITS & SURPLUSES, COBOURG WATERWORKS

Toronto, Jan. 5th. 1923, Made by S.R.W., Checked by L.L.H.

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in 1922 there was a small profit.

Curve "b" is the accumulated deficit of the Cobourg waterworks and the shape of this curve indicates that its operation has approached stability and under present conditions should eventually offset the present accumulated deficit of approximately $27,000. Probably a small increase in the rates would produce this result in a very short time.

The Peterborough Radial Railway.

The curves on page 65 indicate the net result of operations of the Peterborough Railway. As might be expected in a comparatively small city, the results of operations do not appear to be satisfactory. The figures for the curves are derived from the figures given in Exhibit XIII of the same document, the figures for 1922 being taken from the Clarkson report as for the other departments.

COPY

Curve "a" shows the annual result of operations to be a consistent deficit, which apparently is growing greater year by year. In the year 1920 there was a deficit of approximately $21,000, while in 1921 this was $33,000 and in 1922 it was approximately $34,000.

Curve "b" showing the accumulated results of operations indicates that the accumulated deficit to date is almost $120,000, and its shape clearly demonstrates that the situation is rapidly growing worse. There is a possibility of making a better showing by the installation of about a dozen one-man cars, by lowering wages, and by the increase in the traffic as Peterborough continues to

in 1922 there was a small profit.

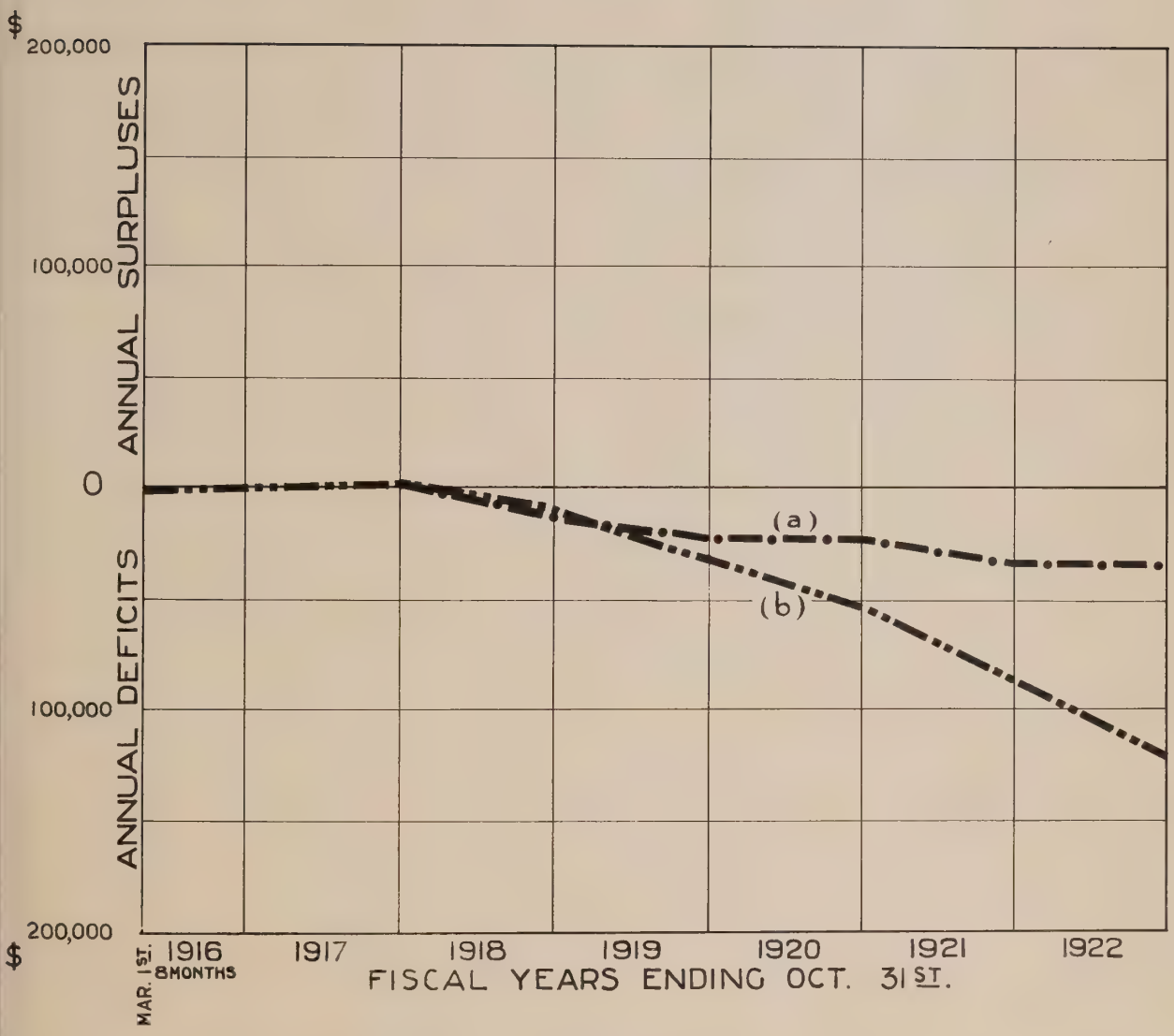
Curve "b" is the accumulated profit of the company assuming the shape of this curve indicates that the operation has attained profitability and under normal conditions would accumulate a very substantial deficit of approximately $2,000. Probably a small increase in the rates would produce this result in a very short time.

The Government Railways

The curves on page 22 indicate the net results of operations of the Government Railway. [illegible] results of operations do not appear to be satisfactory. The figures from the curves are derived from the figures given in Exhibit XIII of the same document. The figures for 1.5% being taken from the Statement showing on the other Exhibit.

Curve "a" shows the annual results of operations to be a considerable deficit, which gradually is growing [illegible] a deficit of approximately $2,000, which is [illegible] it was approximately $18,000.

Curve "b" showing the accumulated results of operations indicates that the accumulated deficit to date is almost $140,000, and is quite obviously [illegible] unless the situation is rapidly changed [illegible]. There is a possibility of making a better showing by the installation of [illegible], by lowering wages, and by the increase in the traffic as [illegible] increases in



ANNUAL RESULTANT OF OPERATION
ACCUMULATED DEFICIT

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ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

ANNUAL & ACCUMULATED DEFICITS AND SURPLUSES, PETERBORO RAILWAY

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recover from the recent industrial depression, but it is doubtful if the railway can ever show revenues equal to the total costs.

The Pulp Mill.

When the Central Ontario System was purchased by the Ontario Government in 1916, it included the pulp mill at Campbellford which has been operated since that time by the Hydro-Electric Power Commission. In order to have an additional source of wood supply, certain areas in Bruton Township were purchased by the Government in 1917 and these also have been operated by the Hydro-Electric Power Commission since 1918. The curves on page 67 indicate the net result of the operation of the Campbellford pulp mill, the barking mill and the Bruton Township pulpwood areas. The figures from which these curves were plotted are given in Exhibit VII and Exhibit XIV of the Price, Waterhouse & Co. report up to the end of 1921, and from 1922 were taken from the Clarkson report.

COPY

Curve "a" indicates the yearly net result of the operations, while curve "b" has been plotted to show the accumulated result to date.

A study of these curves would seem to indicate that an extraordinary condition occurred in 1920, which permitted an enormous profit to be made on the sale of the product in that particular year. Every other year but one shows a considerable loss and the sum of these yearly losses has almost wiped out the unusual profit made in 1920. The net result of operations to date is that there is an accumulated surplus of approximately $68,000 at the credit

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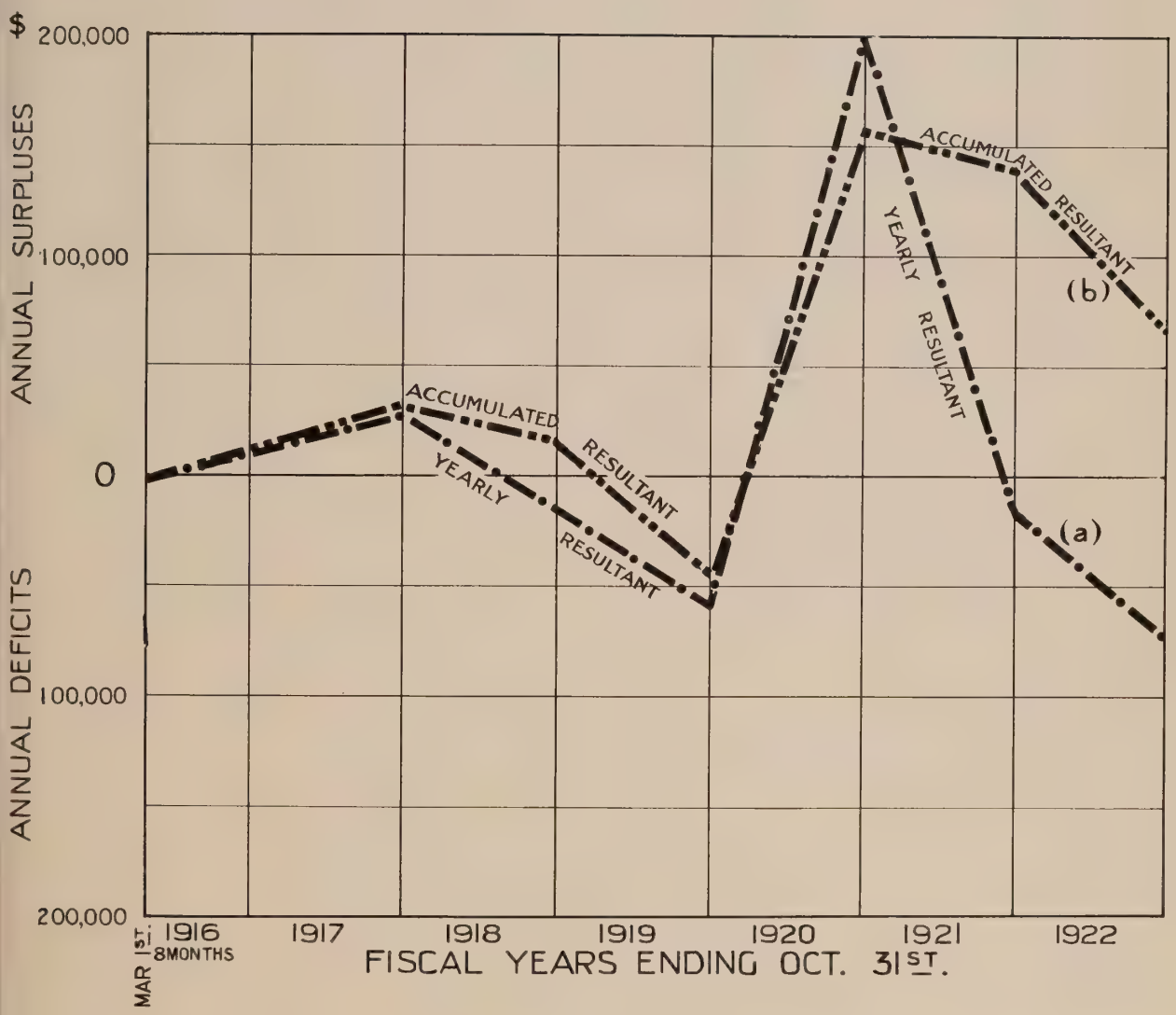

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ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

ANNUAL & ACCUMULATED DEFICITS AND SURPLUSES, PULP-MILL.

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of the pulp mill and pulp land department. It is understood that the mill has been operated in 1922 for a few months only.

Summary.

The results of the studies of the operating records and accounts of these departments of the Central Ontario Section of the Central Ontario System, leads to the conclusion that the combined electric departments are being operated satisfactorily and in such a manner as to carry on the necessary charges under the present system of rates. On the other hand, it would appear that the gas plants, the waterworks, the railway and the pulp mill are in a special category and should be treated as something entirely apart from the ordinary operations of a power system. If they could be satisfactorily disposed of it would greatly simplify the operations of the Central Ontario Section.

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Revenues and Costs per Horse-power per Annum.

In order to reduce the total revenues and total costs for the electrical departments to a basis where these would be comparable with other systems and to agree with the usual practice of similar companies and distribution authorities, a set of diagrams has been prepared to show the revenues per horse-power per annum from different main groups or classifications of consumers and to show the revenue per horse-power per annum for different bases of horse-power use.

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In a similar manner, the total costs for the electrical departments have been reduced to costs per horse-power per annum for different bases of horse-power, and have also been analyzed to show the total annual costs sub-divided into fractional amounts chargeable against each kind of expense based on the horse-power rating of the plants and also on the average horse-power consumed.

The following series of diagrams with the tables of figures for each, show these various items in detail.

Annual Revenues per Horse-power.

The curves given on page 70, entitled "Total Annual Revenue per Horse-power" are derived from the table of total revenues on page 44 hereof and the table of horse-power on page 35. The various revenues for each classification of horse-power are given in the table below and on the sheet of curves on page 73 hereof.

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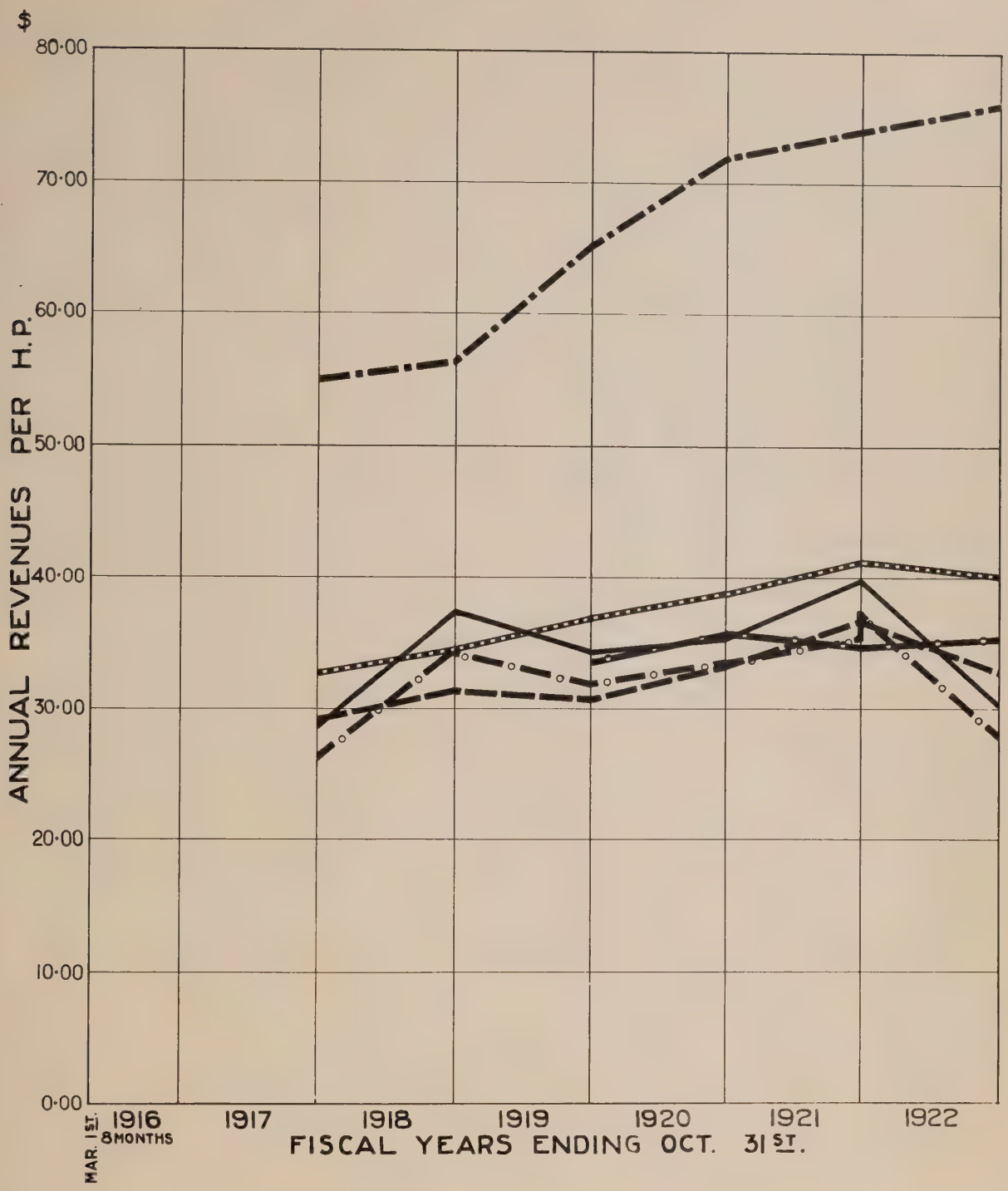
Table of Revenues per Horse-power per Annum

Revenues per Horse-power	1917	1918	1919	1920	1921	1922
Developed	$28.47	$37.10	$34.15	$35.50	$39.75	$30.45
Developed plus Purchasable	26.80	34.50	32.10	33.67	35.70* 37.70*	28.10
Consumed	55.20	56.50	65.80	72.24	74.40	75.20
Billed	.....	.....	33.60	35.85	35.00	35.20
Average of Twelve Monthly Peaks	33.10	34.55	37.40	38.70	41.50	40.30
Maximum Yearly Peak	29.50	31.95	31.20	33.40	37.05	33.10

* These figures for 1921 indicate the addition of the Campbellford purchasable power in July, 1921.



REVENUE PER H.P. CONSUMED
" " " " AVERAGE OF 12 MONTHLY PEAKS
" " " " MAXIMUM YEARLY PEAK
" " " " BILLED
" " " " DEVELOPED
" " " " " PLUS PURCHASABLE

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REVENUES PER H.P. PER ANNUM, VARIOUS H.P. BASES

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For example, in 1921 the total revenue was $1,049,058. The horse-power developed at all the Hydro-Electric Power Commission plants at that time was approximately 26,400 horse-power and the revenue per horse-power per annum on this basis would therefore be $39.75. Similarly the average horse-power consumed in 1921 was 14,095 and the average revenue per horse-power consumed was therefore $74.40.

The table below and the sheet of curves on page 73 entitled "Annual Revenue per Horse-power Consumed and Annual Revenue per Horse-power Billed for Various Classes of Consumers" is derived from the sub-division of the total revenue as given in the table on page 44. The table shows the data for the three principal classes of consumers, namely, (a), private companies and others taking power at fixed rates, (b), municipalities and industries taking wholesale power at cost, and (c), municipalities in which the Hydro-Electric Power Commission distributes retail, and is as follows:

COPY

Annual Revenues per Horse-power Consumed and Annual Revenues per Horse-power Billed for Various Classes of Consumers

	1917	1918	1919	1920	1921	1922
Private Companies etc. at Fixed Rates						
Total Revenue	$132,000	$170,000	$178,654	$213,524	$252,230	$257,780
H.P. Consumed	3,330	4,180	3,865	4,230	4,365	5,000
H.P. Billed	.....	.....	7,871.6	8,693.2	11,757	.....
Revenue per H.P. Consumed	$39.70	$40.67	$46.20	$50.50	$57.80	$51.56
Revenue per H.P. Billed	.....	.....	$22.60	$24.60	$21.40	.....

(Table continued on next page)

For example, in 1931 the total revenue was $1,[illegible],000. The 3,[illegible]-power developed at all the Hydro-Electric Power Commission plants at that time was approximately 50,000 horse-power and the revenue per horse-power per annum on this basis would therefore be $[illegible].75. Adjusting the average horse-power in 1931 and 1[illegible] and the revenue per horse-power per annum [illegible]

The table below has the about of curves on page 74 relating "Annual Revenue per Horse-power Sold" and "Average Revenue per Horse-power Sold" for Various Classes of Consumers" is derived from the sub-division of the total revenue as given in [illegible] the three principal classes of consumers, (1), municipalities and industrial power at cost, and (2), municipalities in which the Hydro-Electric Power Commission distribution system, and is as follows:

Annual Revenues per Horse-power Generated and Average Revenue per Horse-power Sold for Various Classes of Consumers

	1927	1928	1929	1930	1931	1932
Public Corporations						
Municipalities						
Total Revenue	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]
H.P. Generated	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
H.P. Sold	.....	.....	[illegible]	[illegible]	[illegible]	.....
Revenue per h.p. Generated	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Revenue per h.p. Sold	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Annual Revenues per Horse-power Consumed and Annual Revenues per Horse-power Billed for Various Classes of Consumers
(Continued)

	1917	1918	1919	1920	1921	1922
Municipalities and Industries at Cost						
Total Revenue	$97,117	$119,024	$148,544	$159,905	$187,304	$180,506
H.P. Consumed	3,518	3,255	3,725	4,205	5,030	4,030
H.P. Billed	.....	.....	6,566	6,877.9	7,328	.....
Revenue per H.P. Consumed	$27.60	$36.60	$39.90	$38.00	$37.20	$44.80
Revenue per H.P. Billed	.....	.....	$22.60	$23.20	$25.60	.....
Municipalities in which H.E.P.C. Distributes Retail						
Total Revenue	$385,025	$520,137	$408,197	$525,098	$582,650	$668,557
H.P. Consumed	4,705	7,275	4,030	4,530	4,695	5,485
H.P. Billed	.....	.....	8,281.5	10,527.3	10,861.3	.....
Revenue per H.P. Consumed	$81.84	$71.50	$101.29	$115.90	$124.10	$121.90
Revenue per H.P. Billed	.....	.....	$49.30	$49.69	$53.70	.....

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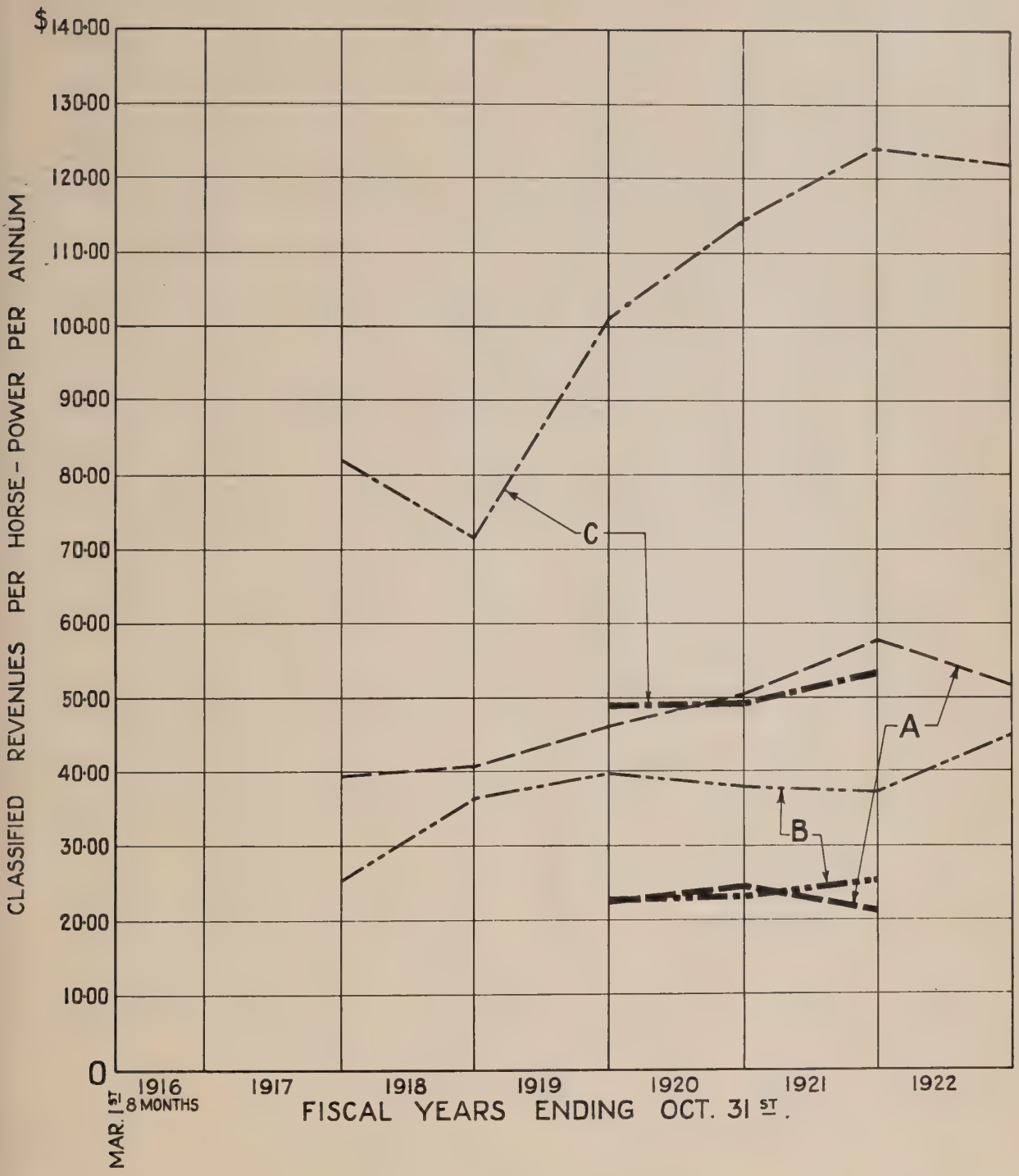
The sub-division of the total revenue as among these classes of consumers was derived from the Clarkson report entitled "Detailed Operating Costs for Each of the Four Years Ending 31st October, 1922", Hydro-Electric Inquiry Commission file 207a, dated November 20th, 1922, by grouping these under their proper headings. The figures for 1917 and 1918 were estimated by analogy from a sub-division of the revenues given by Price, Waterhouse & Co. The billed horse-power applicable to the three groups was found in the same way from the same



NOTE :

Class **A** · Power Consumers and Municipalities supplied at fixed rates
per H.P. Billed, shown thus
per H.P. Consumed, " "

Class **B** · Municipalities and Industries supplied at cost
per H.P. Billed, " "
per H.P. Consumed, " "

Class **C** · Municipalities in which H.E.P.C. distributes retail
per H.P. Billed, shown thus
per H.P. Consumed, " "

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ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

REVENUES PER H.P. PER ANNUM BY CLASSIFIED CUSTOMERS

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documents.

The curves on page 73 are plotted as a separate record above the base line and the distance from the curve to the base line for each class is to be taken for reading the total revenue per horse-power for each class of consumer. For example, in 1921 the revenue per horse-power consumed for class "a" was $57.80, for class "b", $37.30 and for class "c", $124.10. Similarly for the amounts of power billed to the respective classes, the revenue per horse-power for class "a" was $21.40, for class "b", $25.60 and for class "c", $53.70.

A study of these curves indicates that the annual revenue per horse-power for the retail customers is several times as great as for the wholesale customers. This is in accordance with the usual results found in practice as the additional distribution costs must be met by correspondingly large revenues in order to show a satisfactory result at the end of the operating period.

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Another interesting result shown by the curve is the much greater diversity between the power billed and the power consumed in the case of retail consumers than in the case of wholesale users, as shown by the distance between the corresponding lines for classes "a", "b" and "c" respectively.

Annual Costs per Horse-power.

The three following sheets of curves and the tables below show the details of the costs per horse-power per annum on different bases. The figures from which the curves were plotted are the figures for the operating costs given in

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the table on page 47 divided by the figures for the various classes of horse-power already given in the text. The sheet of curves included as page 77 indicates the total costs per horse-power per annum for the different classifications of horse-power already discussed. For example, in 1921 the average cost per horse-power consumed is $72.80 and the average cost per horse-power developed is $38.78 and similarly for the other points on the curves for any particular year.

The sheet of curves on page 78 entitled "Sub-divided Costs per Horse-power for Power Developed plus Purchasable" indicates the sub-division of the total annual costs as between operating, maintenance, overhead and general expense, interest, renewals and contingencies divided by the total amount of horse-power developed in the various plants of the Hydro-Electric Power Commission, plus that available from the Peterborough Hydraulic Power Co. and Campbellford Municipal Plant, or in other words, the total available output. For example, in 1921 the operating costs per horse-power developed plus purchasable were $7.26, while the maintenance charges were $3.57 per horse-power, making the total for maintenance and operation together $10.83. Similarly the sum of all of the various items for 1921 give a total delivered cost of $34.80.

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The sheet of curves included as page 79 is similar to that just described except that it is based on the average horse-power consumed per annum and gives the annual costs on that basis.

The figures forming the basis of the three sheets of curves referred to above are as follows:

Table of Costs per Horse-power per Annum

	1917	1918	1919	1920	1921	1922
H.P. Developed	$30.40	$34.08	$37.50	$35.30	$38.78	$28.70
H.P. Developed plus Purchasable	28.66	32.08	35.30	33.50	34.74 36.80	26.50
H.P. Consumed	59.10	52.00	72.25	71.85	72.62	71.87
H.P. Billed	.....	.....	36.95	35.70	34.20	33.00
H.P. Average of Monthly Generated Peaks	34.90	31.80	41.10	38.50	40.40	38.00
H.P. Maximum Yearly	31.55	29.40	34.30	33.25	36.30	31.20

Table of Sub-divided Costs per Horse-power Developed plus Purchasable

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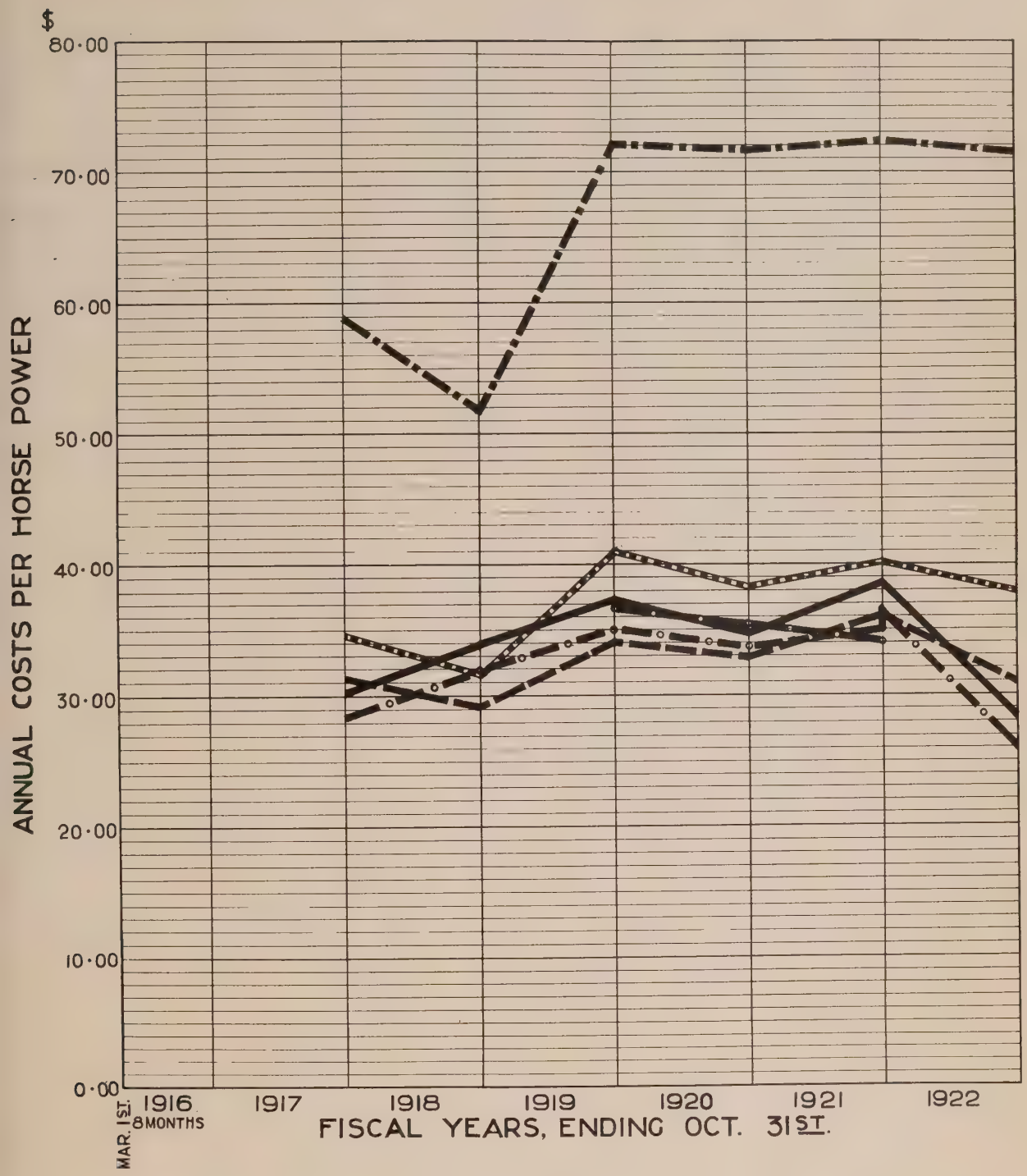
	1917	1918	1919	1920	1921	1922
Operating Costs including Power Purchased	$ 7.10	$ 9.05	$ 9.05	$ 7.57	$ 7.26	$ 5.50
Maintenance	1.17	1.96	2.95	3.30	3.67	2.79
Overhead and General Expense	4.25	4.24	4.63	4.85	5.50	4.22
Interest	11.28	11.53	12.77	12.37	12.33	9.69
Renewals	4.71	5.01	5.66	5.17	5.16	4.11
Contingencies	.15	.29	.24	.24	.92	.19
Total	$28.66	$32.08	$35.30	$33.50	$34.74	$26.50

Table of Sub-divided Costs per Horse-power Consumed

	1917	1918	1919	1920	1921	1922
Operating Costs including Power Purchased	$14.67	$14.62	$18.53	$16.26	$15.12	$14.91
Maintenance	2.42	3.17	6.05	7.07	7.47	7.66
Overhead and General Expense	8.75	6.88	9.53	10.40	11.61	11.40
Interest	23.24	18.71	26.18	26.54	25.71	26.33
Renewals	9.72	8.15	11.48	11.08	10.78	11.14
Contingencies	0.30	0.47	0.48	0.50	1.93	0.53
Total	$59.10	$52.00	$72.25	$71.85	$72.62	$71.87



PER AVERAGE H.P. CONSUMED
PER AVERAGE OF MONTHLY GENERATED PEAKS
PER H.P. BILLED
PER H.P. DEVELOPED PLUS PURCHASABLE
PER H.P. DEVELOPED
PER H.P. AVERAGE OF YEARLY PEAKS

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ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

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COSTS PER H.P. PER ANNUM, VARIOUS H.P. BASES

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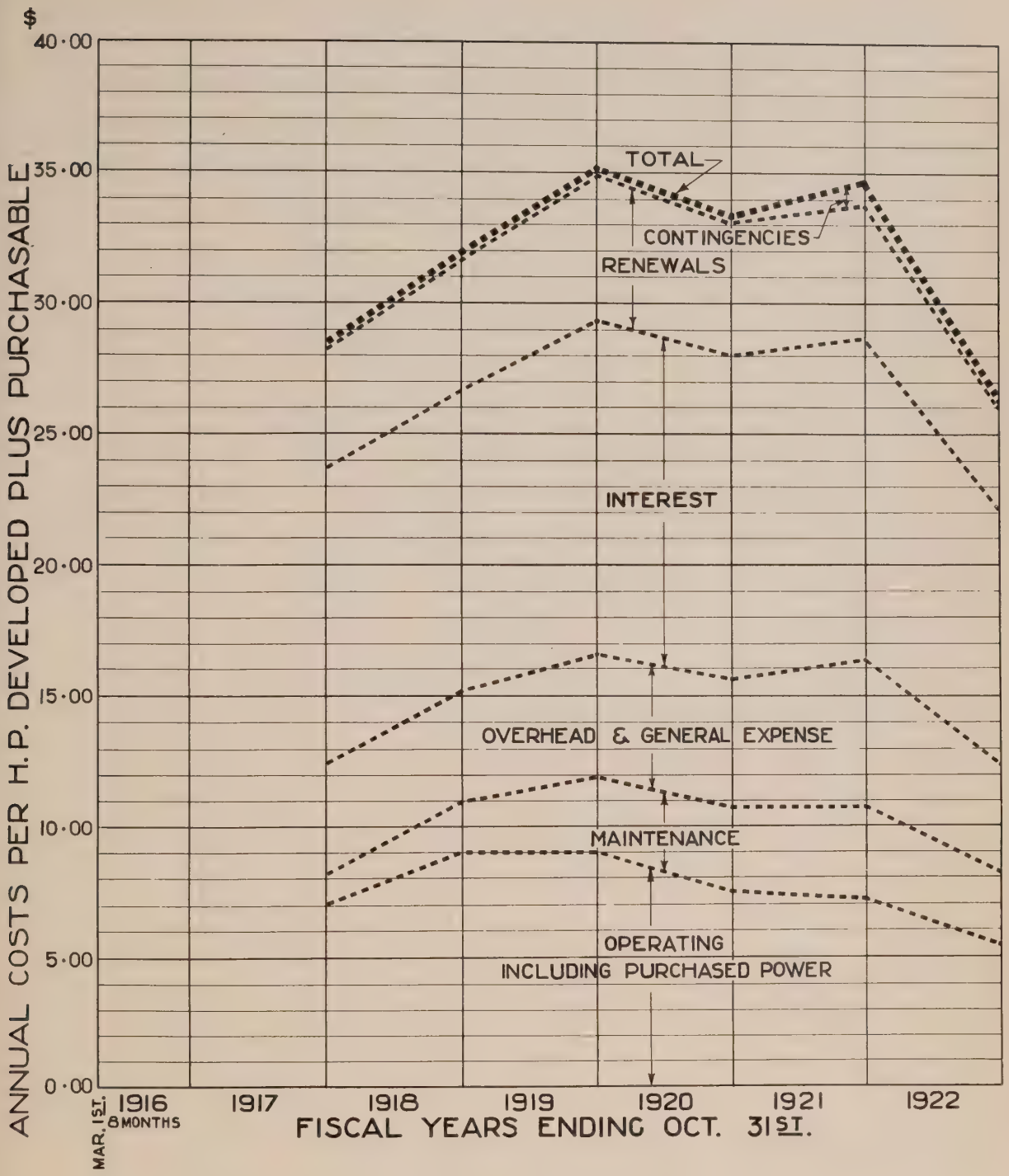

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ECONOMICS OF H.E.P.C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

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SUBDIVIDED COSTS PER H.P. DEVELOPED PLUS PURCHASABLE PER ANNUM

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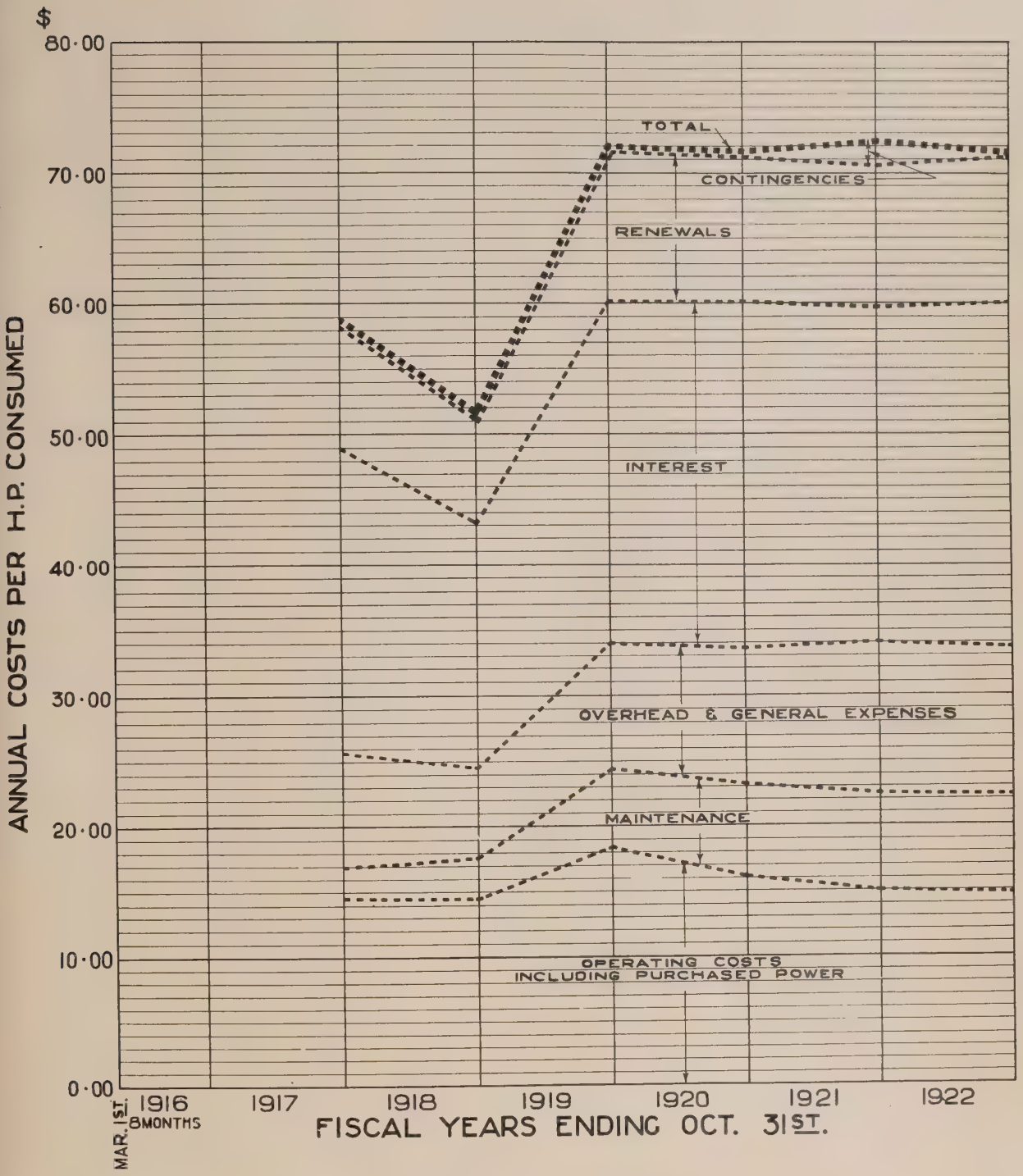

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SUBDIVIDED COSTS PER H. P. CONSUMED PER ANNUM

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Kilowatt Hour Data and Annual Revenues and Costs per Kilowatt Hour.

Kilowatt Hours Consumed.

Mr. L. G. Ireland, the Manager of the Central Ontario System, has supplied a complete record of the kilowatt hours consumed by the principal customers on the Central Ontario Section of the Central Ontario System for each fiscal year ending October 31st, up to and including 1922. The consumers have been subdivided into three main classifications and the total kilowatt hours consumed by each class of consumer has been plotted in the curves shown on page 81. From this series of curves will be seen the relative usage of the various classes of consumers. A very interesting result is shown in the third classification designated class "c" namely, those municipalities in which the Hydro-Electric Power Commission distributes retail. In the years 1917 and 1918 a very marked peak appears which was evidently due to the heavy demand of the various munition plants using power during the later war years. In October 1918, the plant of the British Chemical Co. at Trenton was burned and this Company ceased to take electric energy. The Armistice in November of 1918 caused the gradual shutting down of many plants making munitions. These results are graphically shown in the sharp drop in consumption for the year 1919.

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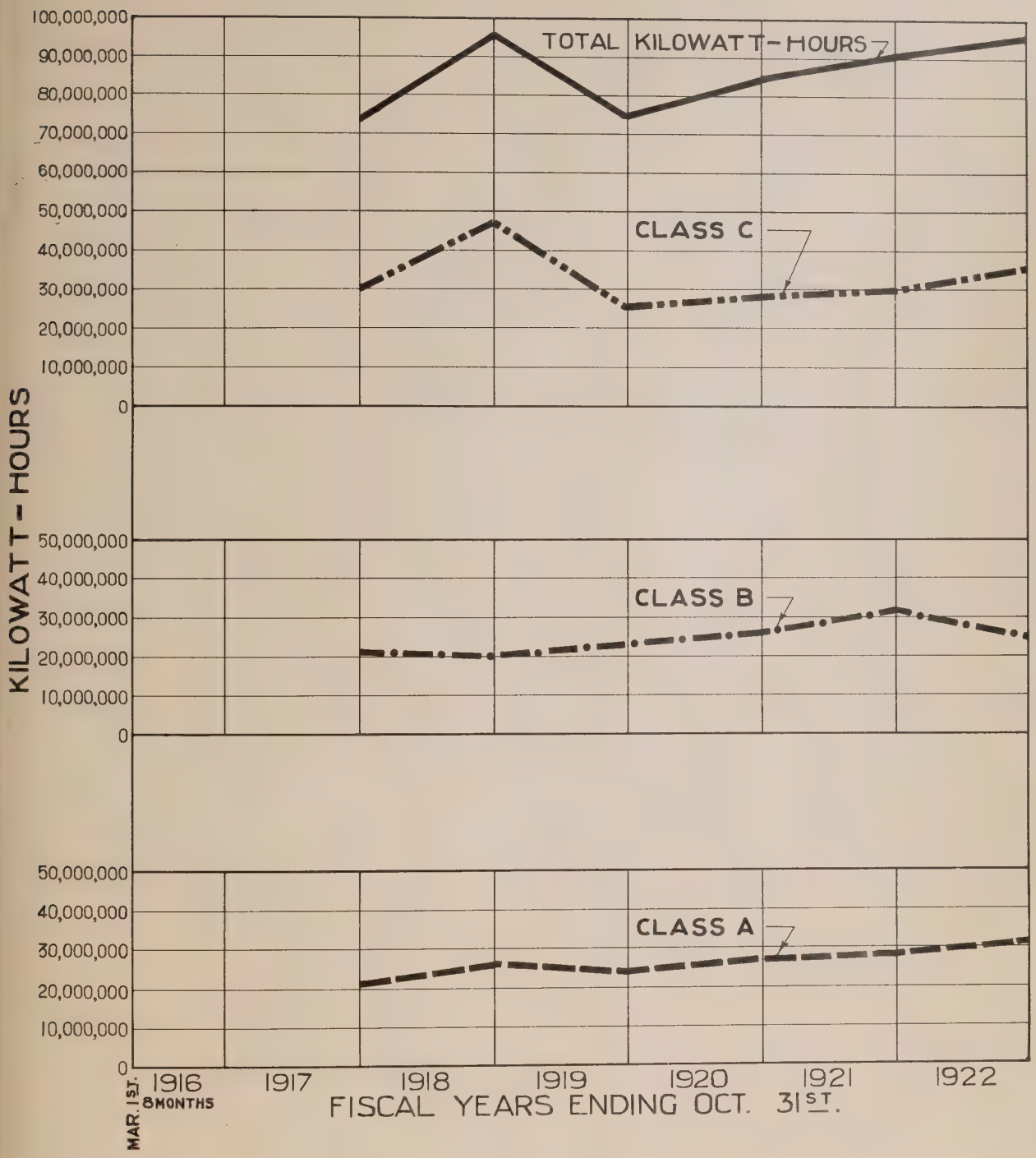
The following table shows the number of kilowatt hours per consumer in each of the fifteen municipalities for each year from 1917 to 1922.



NOTE:-

Class A - Private companies and municipalities supplied wholesale at fixed rates.

Class B - Municipalities and industries supplied wholesale at cost.

Class C Municipalities in which retail distribution is done by H. E. P. C.

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CENTRAL ONTARIO SYSTEM

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KILOWATT-HOURS CONSUMED PER ANNUM, BY CLASSES

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Table of Kilowatt Hours per Consumer in Fifteen Municipalities

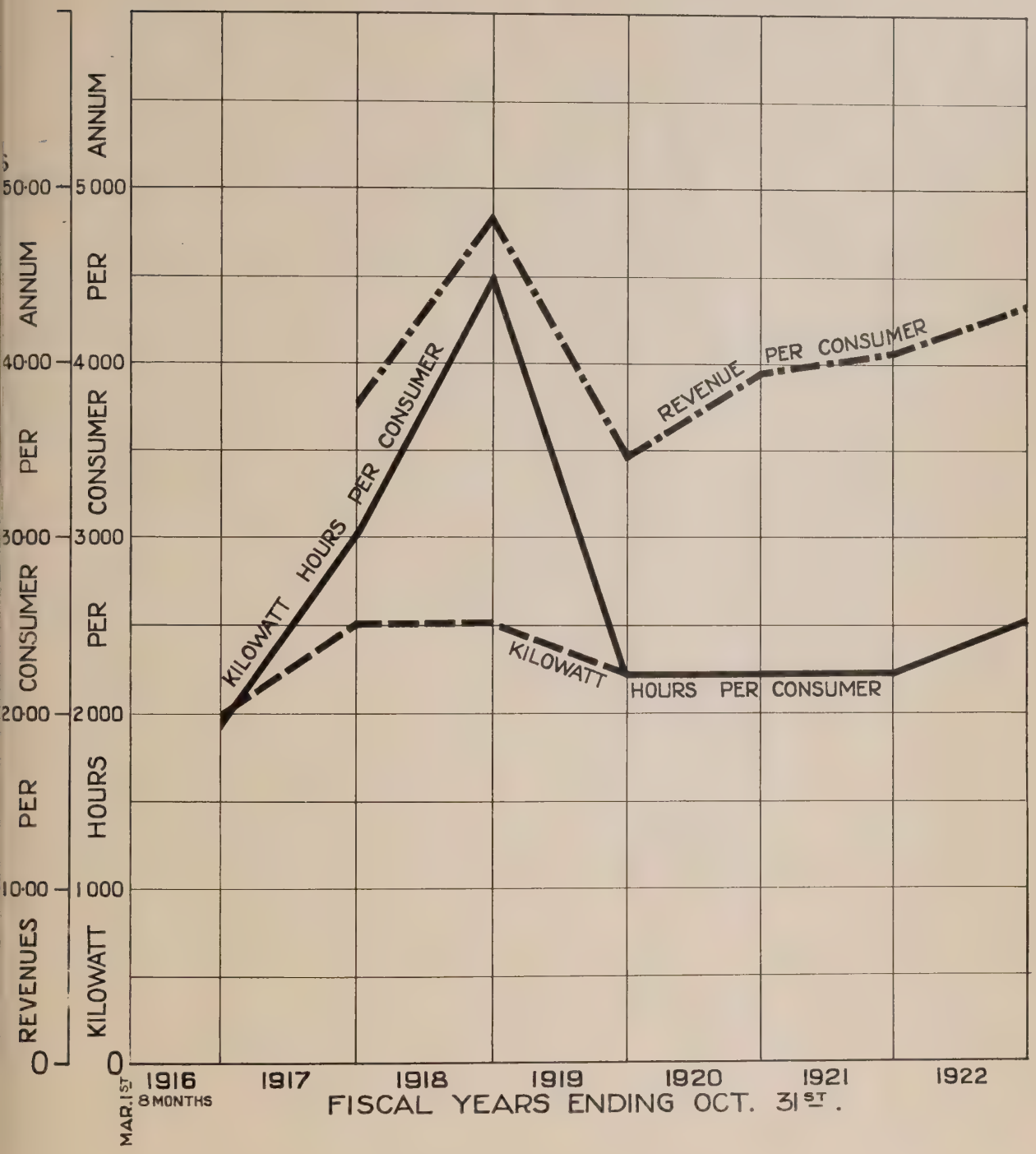
	1917	1918	1919	1920	1921	1922
Belleville	2,290	2,700	2,020	1,940	2,004	2,325
Bowmanville	6,930	4,320	3,950	4,050	4,170	3,750
Brighton	460	552	573	386	718	790
Cobourg	2,270	2,270	1,970	2,190	2,045	2,380
Deseronto	4,560	4,270	3,010	2,480	2,194	2,110
Lindsay	2,920	3,600	3,450	2,480	2,250	2,030
Millbrook	445	440	386	454	542	580
Napanee	1,600	1,510	1,300	1,120	1,490	1,610
Newburgh and Camden East	3,000	3,430	4,930	3,810	1,310	4,140
Newcastle	290	333	377	410	490	527
Orono	330	365	400	410	525	540
Oshawa	2,890	2,780	2,670	3,580	3,210	3,600
Port Hope	1,290	1,400	1,120	1,530	1,320	1,470
Trenton	7,350	* 20,000	1,960	1,490	1,440	1,600
Tweed	720	570	925	620	670	634
Total K.W.H.	30,762,734	47,521,220	26,329,276	29,641,853	30,682,640	38,895,071
Total Consumers	10,164	10,754	11,743	13,241	14,320	15,315
K.W.H. per Consumer	3,030	4,510	2,240	2,240	2,240	2,540

* Includes British Chemical Co. using about 20,000,000 kilowatt hours with a peak load of about 5,000 horse-power.

A sheet of curves showing the average kilowatt hours per consumer and the average revenues per consumer from the above table is included on the following page.

Revenues per Kilowatt Hour.

From the total kilowatt hour figures divided into three main classifications and the total revenues in dollars for each of the three classes, curves



NOTE :

The K.W.H. per Consumer from 1916 to 1919 inclusive are plotted for fifteen and fourteen municipalities, Trenton being a special case during that period. From 1919 the curve shows the result in fifteen municipalities.

The revenue curve is plotted throughout for fifteen municipalities.

HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

AVERAGE K.W.H. CONSUMED & REVENUES PER CONSUMER PER ANNUM (15 MUNICIPALITIES)

Toronto, Jan. 5th. 1923; Made by ..., Checked by ...

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS

have been plotted showing the income per kilowatt hour for each main class of consumer. These results are shown graphically in the curves on page 86.

They were obtained by dividing each main portion of revenue by the number of kilowatt hours applicable to that portion. The average curve indicated on the sheet is the result of dividing the total revenue by the total number of kilowatt hours per annum and gives the average annual revenue per kilowatt hour for the whole of the Central Ontario (Trent) Section.

The figures for these curves were plotted from the following data:

Table of Revenues per Kilowatt Hour Consumed

COPY

	Fiscal Year Ending October 31st, 1917	1918	1919
(a) Power Sold to Companies and Others at Flat Rates			
Kilowatt Hours	21,730,189	27,314,365	26,293,515
Revenue	$ 132,000	$ 170,000	$ 178,651
Cents per Kilowatt Hour	0.608	0.623	0.704
(b) Wholesale Power Sold at Cost			
Kilowatt Hours	22,992,389	21,292,136	24,374,598
Revenue	$ 97,117	$ 119,024	$ 148,544
Cents per Kilowatt Hour	0.423	0.559	0.607
(c) Power Sold to Retail Consumers			
Kilowatt Hours	30,762,734	47,521,220	26,329,278
Revenue	$ 385,025	$ 520,137	$ 408,197
Cents per Kilowatt Hour	1.25	1.095	1.55
Total Kilowatt Hours	75,485,312	96,127,721	75,997,391
Total Revenue	$ 637,660	$ 830,756	$ 765,929
Average Cents per Kilowatt Hour	0.845	0.866	1.01

(Table continued on following page)

have been plotted showing the income per kilowatt hour for each year, given in [illegible]. These results are shown graphically in the curves on page 6a.

They were obtained by dividing each particular revenue by the number of kilowatt hours applicable to that province. The average curve included on the sheet is the result of dividing the total revenue by the total number of kilowatt hours per annum and gives the average annual revenue per kilowatt hour for the whole of the Central Ontario (Power) Section.

The figures for the [illegible] have been plotted from the following [illegible]

Table of revenue per kilowatt hour (revenue

COPY

	[illegible]	[illegible]	[illegible]
(a) [illegible]			
Kilowatt hours	[illegible]	[illegible]	[illegible]
Revenue	$ [illegible]	$ [illegible]	$ [illegible]
(b) [illegible]			
Kilowatt hours	[illegible]	[illegible]	[illegible]
Revenue	$ [illegible]	$ [illegible]	$ [illegible]
(c) Power sold to [illegible]			
Kilowatt hours	[illegible]	[illegible]	[illegible]
Revenue	$ [illegible]	$ [illegible]	$ [illegible]
Total kilowatt hours	[illegible]	[illegible]	[illegible]
Total Revenue	$ [illegible]	$ [illegible]	$ [illegible]

Table of Revenues per Kilowatt Hour Consumed (continued)

	Fiscal Year Ending October 31st, 1920	1921	1922
(a) Power Sold to Companies and Others at Flat Rates			
Kilowatt Hours	27,662,667	28,501,002	32,681,710
Revenue	$ 213,524	$ 252,230	$ 257,780
Cents per Kilowatt Hour	0.769	0.885	0.786
(b) Wholesale Power Sold at Cost			
Kilowatt Hours	27,466,252	32,847,823	26,359,537
Revenue	$ 159,905	$ 187,304	$ 180,506
Cents per Kilowatt Hour	0.583	0.570	0.684
(c) Power Sold to Retail Consumers			
Kilowatt Hours	29,641,853	30,682,640	35,895,071
Revenue	$ 525,098	$ 582,650	$ 668,537
Cents per Kilowatt Hour	1.77	1.90	1.86
Total Kilowatt Hours	84,770,772	92,031,465	94,936,318
Total Revenue	$ 935,547	$ 1,049,056	$ 1,108,608
Average Cents per Kilowatt Hour	1.104	1.14	1.17

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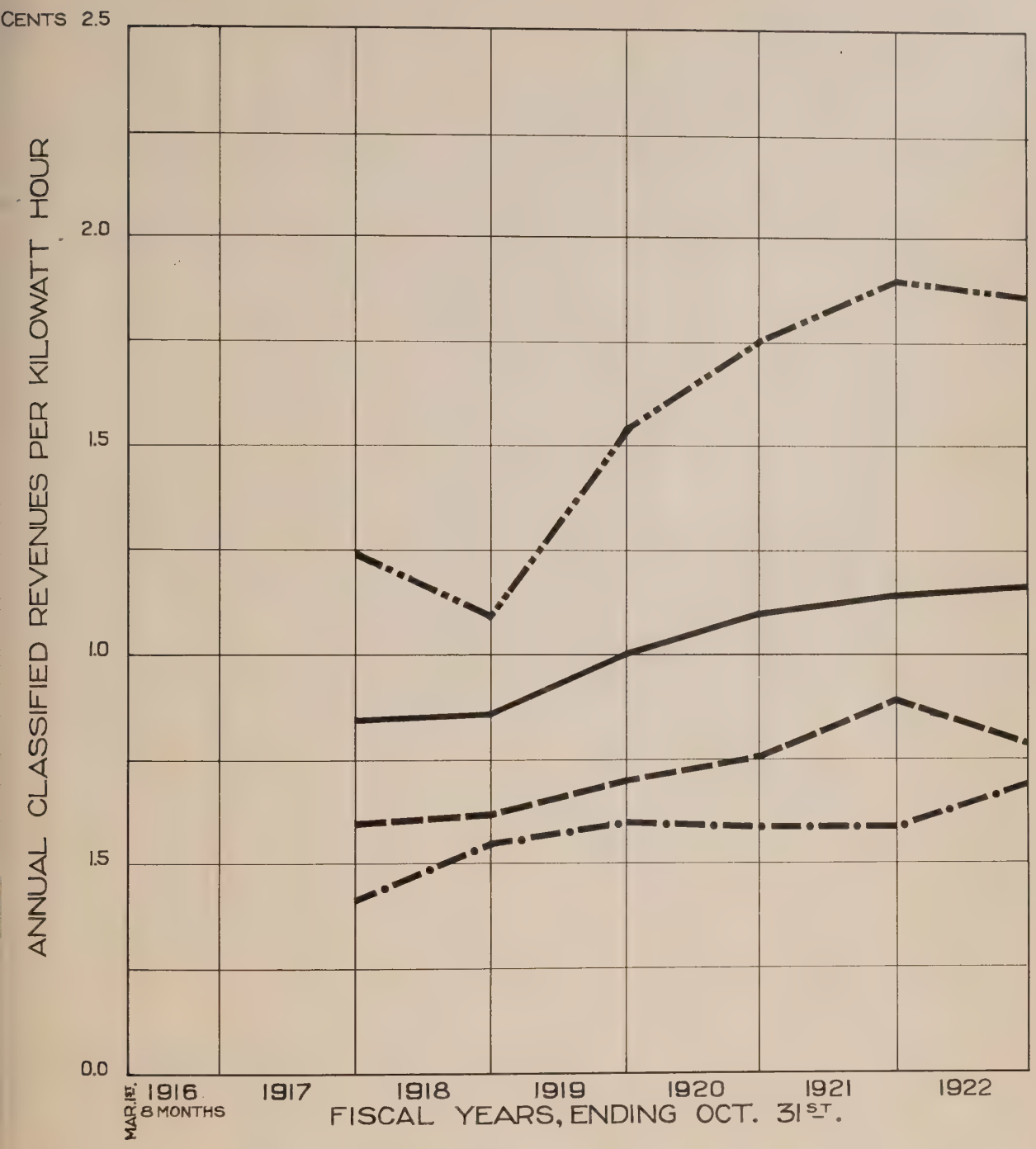
Costs per Kilowatt Hour.

It was impossible to sub-divide the operating costs against each main classification of power users. It was therefore decided to plot the unit costs per kilowatt hour by means of fractional curves showing that part of the total cost applicable to operating costs, maintenance, overhead and general expense, interest, renewals and contingencies in a similar manner to that already



CLASS **A** SHOWN THUS
CLASS **B** " "
CLASS **C** " "
AVER. REVENUE PER K.W.H.

NOTE:

ALL CURVES ARE REFERRED TO THE ZERO LINE

FOR EXPLANATION OF CLASSES SEE SHEET ENTITLED "KILOWATT HOURS CONSUMED PER ANNUM, BY CLASSES"

HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

REVENUES PER K.W.H.
CLASSIFIED BY CONSUMERS

Toronto, Jan. 5th., 1923. Made by C.S.S. Checked by L.L.H.

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS

described for the various horse-power bases. This was accordingly done and the table below and the set of curves on page 88 shows the total fractional cost in cents per kilowatt hour for each year.

Table of Sub-divided Costs per Kilowatt Hour

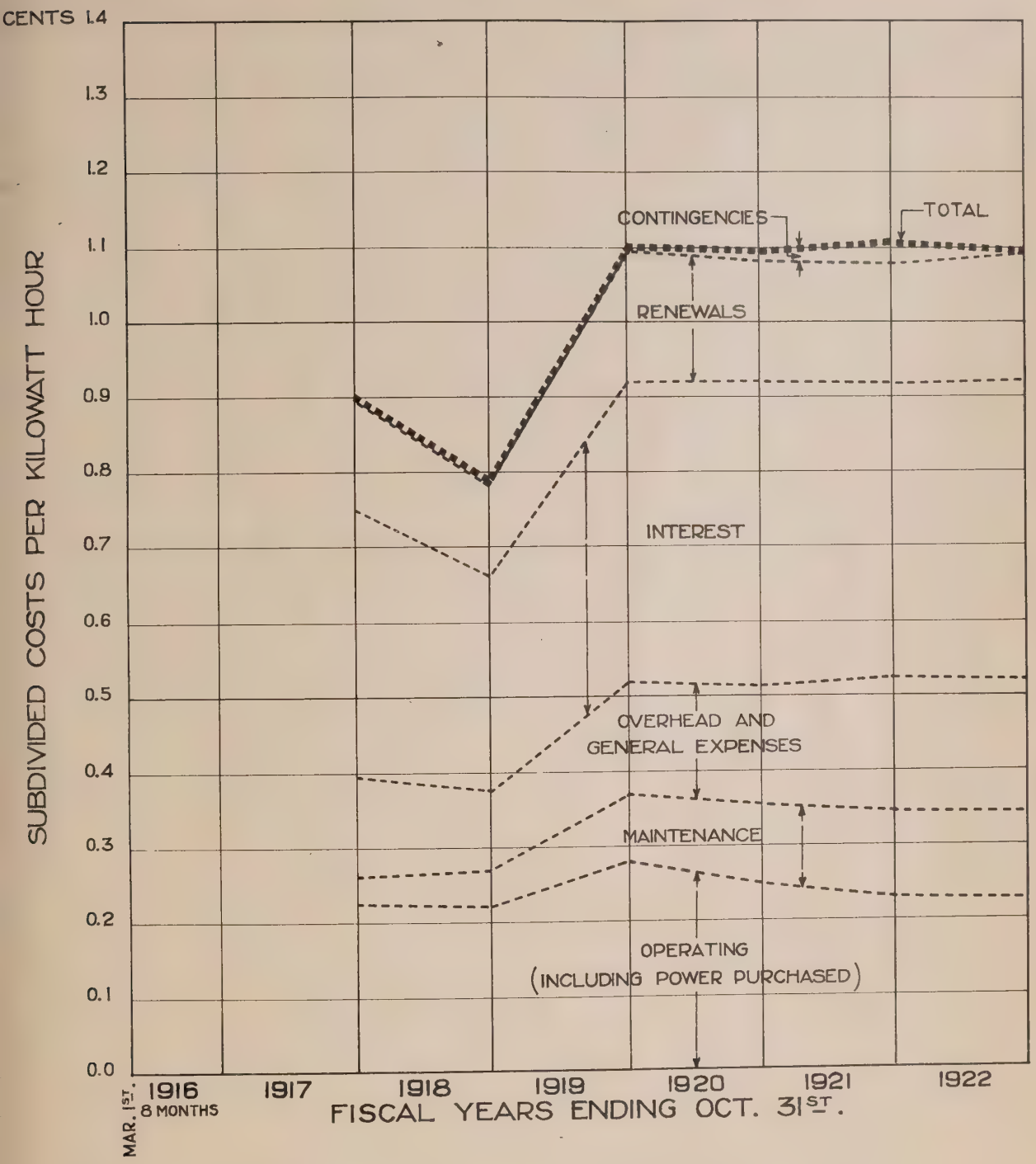
	1917	1918	1919	1920	1921	1922
Operating Costs (including Power Purchased)	0.225	0.224	0.283	0.249	0.232	0.229
Maintenance	0.037	0.048	0.092	0.108	0.115	0.116
Overhead and General Expense	0.134	0.105	0.145	0.159	0.178	0.175
Interest	0.355	0.285	0.401	0.406	0.393	0.402
Renewals	0.147	0.124	0.176	0.170	0.163	0.170
Contingencies	0.004	0.007	0.007	0.006	0.029	0.008
Total Cents per Kilowatt Hour	0.902	0.793	1.104	1.10	1.11	1.10

COPY

For example, in 1921 the cost per kilowatt hour for operation was 0.232 cents, for maintenance it was 0.115 cents, the total of these two being 0.347 cents and so on for each particular item of operating cost or fixed charges, the total for that year being 1.11 cents.

Results of Operations per Kilowatt Hour.

The curves on page 89 show the total annual results per kilowatt hour. One curve indicates the total annual revenues per kilowatt hour, another curve the total annual costs per kilowatt hour, and the curve near the zero or datum line gives the total annual surplus or deficit per kilowatt hour. An examination of the latter indicates that the operations of the electrical departments



HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

SUBDIVIDED COSTS PER K.W.H. CONSUMED

Toronto, Jan. 5th, 1923, Made by SRK, Checked by RLH

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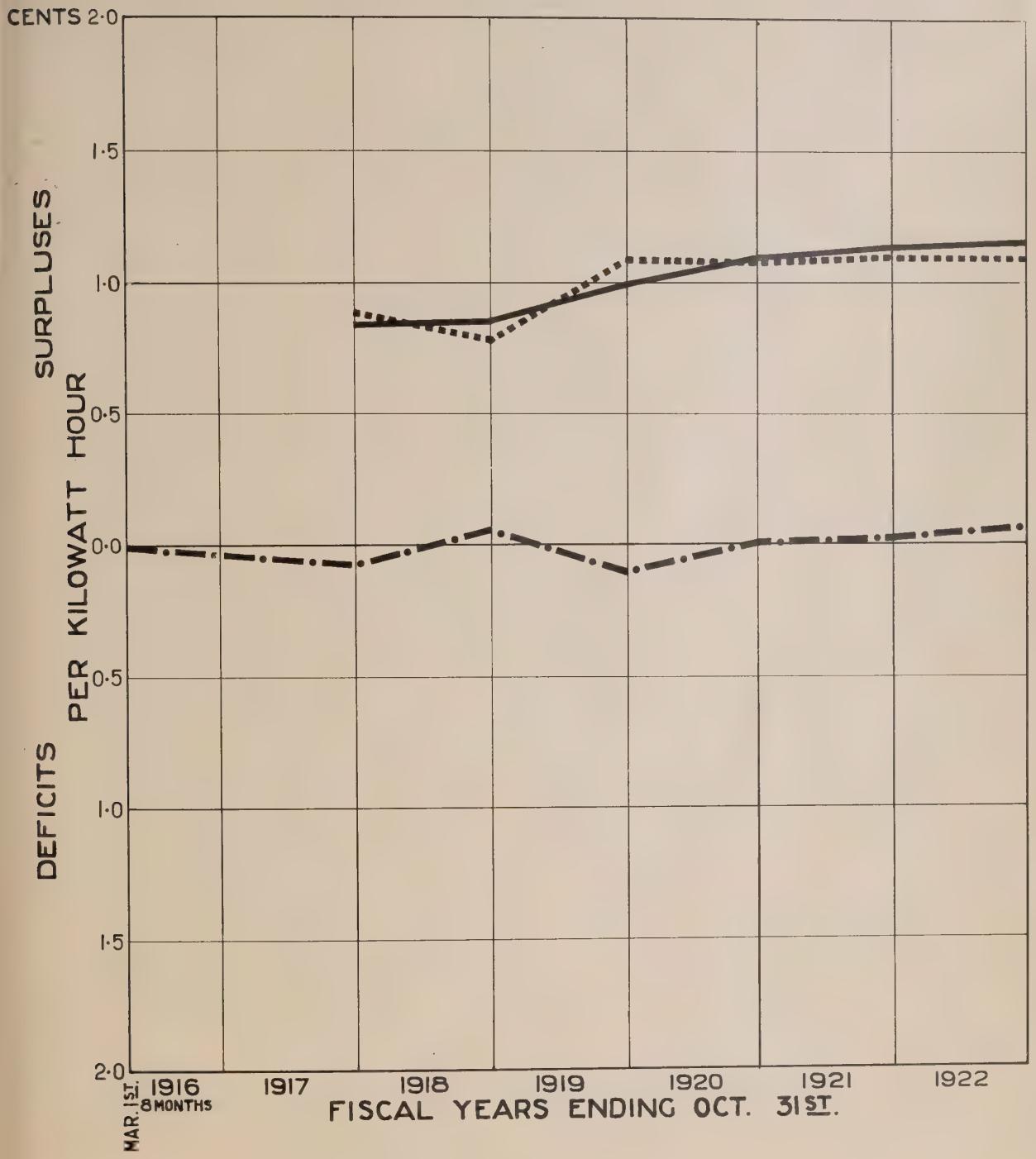

Annual Costs Per K.W.H. .....

Annual Revenues Per K.W.H. ———

Annual Surplus or Deficit Per K.W.H. —·—·—

Hydro-Electric Inquiry Commission
W. D. Gregory, Chairman

Economics of H. E. P. C. Distribution Systems

Central Ontario System

Central Ontario Section

SURPLUSES OR DEFICITS PER K.W.H.

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are practically stabilized and the results since 1920 show a small, but regular profit each year.

Summary.

A summary of a number of the more salient points which have been studied and discussed in the foregoing report may be of advantage in continuing the consideration of the economics of the Central Ontario System. They are as follows:

(1) The capital costs of the electrical departments of the System show a heavy charge for intangibles and undeveloped properties. The original purchase price of the whole System included a sum of over $2,600,000 for intangible values. Nearly the whole of the cost of the undeveloped properties on the System is included in this figure, the actual cash invested in them being comparatively small. Further study should be given to the question of amortization of the intangible values which should be considered when the refinancing of the System is carried out in 1926. Meanwhile, that part of the purchase price allocated to intangibles and belonging to the electrical departments and amounting to about $2,400,000 is a considerable burden on the enterprise.

(2) The capital costs of the extension to power plants, transformer stations and main lines made by the Government since taking over the System in 1916 have apparently been based primarily on maximum physical efficiency, long life and uninterrupted service rather than on the usual commercial conditions for a privately owned enterprise.

(3) To facilitate future economic studies, records of kilowatt hours used at each principal consuming point on the System should be maintained, where such is not already done. On the Central Ontario Section the records are fairly complete.

(4) The Hydro-Electric Power Commission has no control over the waters which supply the various power plants on the Central Ontario Section of the System. This control is vested in the Department of Railways and Canals, Canada, primarily for navigation purposes. The relations of the Commission and the Federal Government should be studied having in mind a unified control which would take all interests into consideration based

COPY

on their relative importance.

(5) Consideration should be given to the question of capitalizing the values of the water rentals charged by the Federal Government if total capital costs of construction are to be studied in comparison with those on other systems.

(6) The market for power has been well covered. The density indicates a high percentage of consumers per capita of population and the use of power per capita compares well with other districts of similar character. The demand for power is apparently still growing rapidly and indications are that further sources of power supply must be provided immediately. The ultimate demand for power and the ultimate source of supply should also be considered because the local economical power sites will soon be all utilized.

(7) The reserve for renewals should be carefully considered in its relation to the recently revised estimated useful life for various portions of the property, and also adjusted to allow for the actual cost of money year by year.

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(8) The whole question of sinking funds should be studied having in mind possible complications in connection with those places which have options to purchase their local systems, and in those other municipalities where formal contracts with the Commission require sinking funds to be established and where this has not been done. When the present bond issue matures in 1926 the question of sinking fund for the refinancing will also require careful consideration.

(9) The reserve for contingencies has been called upon to replace properties damaged or destroyed by catastrophe to the extent of nearly the whole accumulated fund. This indicates that the reserve for contingencies should be substantially increased as soon as possible and yearly results noted so as to eventually devise a proper yearly allowance for the fund.

(10) The results of operations of the various departments indicate the desirability of keeping separate records as at present for the combined electrical departments, the three gasworks at Peterborough, Oshawa and Cobourg, the waterworks at Cobourg, the Peterborough Radial Railway, and the pulp mill properties. The latter departments outlined are extraneous to the ordinary operations of a power system and if possible should be separated from the electrical departments. The gasworks show deficits but are improving and should soon be self-supporting; the pulp mill is uncertain; the Cobourg waterworks is now meeting expenses; and the Peterborough Railway is rapidly becoming more and more of a burden. Consideration should be given to satisfactorily disposing of all these departments.

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(11) The records for 1917, 1918 and 1919 show extraordinary load conditions due to the rapid increase in loads of munition plants and makers of supplies during the later war period and the subsequent rapid decrease in demand following the Armistice in November, 1918. The costs and revenues in these three years are therefore abnormal.

(12) The records show that the average revenues per kilowatt hour are increasing, that the average use of electricity per consumer has not recently been increasing to any marked extent, and that the average costs per kilowatt hour have been practically constant for four years. This is explained by the statement that the average use of electricity for power purposes is less than formerly and that the domestic use of current is increasing at the larger rates charged for this latter class of service, rather than that there has been a general increase in rates during the past few years. The recent business depression probably accounts for the result.

(13) The costs and revenues sub-divided as between three main classes of consumers indicate that the wholesale consumers are the least remunerative portion of the enterprise and that in some cases they are receiving power at less than the average cost of producing it. The general result of the operations of the electrical departments is that the System as a whole is becoming stabilized. Some of the internal details are somewhat unsatisfactory and will require further study and adjustment.

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(14) The Canada Cement Company contract is a very heavy burden on the enterprise. The supply of power to this consumer has resulted in a very heavy net loss up to the present time, the figure being of the order of $100,000. This consumer has been receiving power at less than 0.4 cents per kilowatt hour on the average since 1919, whereas the average cost of power for the System since 1919 has been approximately 1.1 cents per kilowatt hour. This contract being renewable until 1940 is most disadvantageous, and should if possible be cancelled or modified. The difficulty is that it is one which was taken over from the Electric Power Company in 1916.

Certain of the other consumers taking power at fixed rates are also receiving their power at less than the average cost of production and delivery for the System.

Walter J. Francis

Consulting Engineer.

Supplementary Note.

Since the diagrams on pages 59, 65 and 67 were prepared, information has been received to the effect that certain adjustments in the actual cost of power supplied in 1919 and 1920 for the Peterborough Radial Railway and for the Campbellford Pulp Mill, as mentioned in the report of Price, Waterhouse & Co., dated October 26th, 1922, have been made in the accounts of the Central Ontario System. This does not affect the results for the System as a whole, but is simply a matter of inter-departmental book-keeping, the debits charged against the railway and the pulp mill being credited to the power department.

COPY

The accumulated resultants of operations to October 31st, 1922, are now as follows:

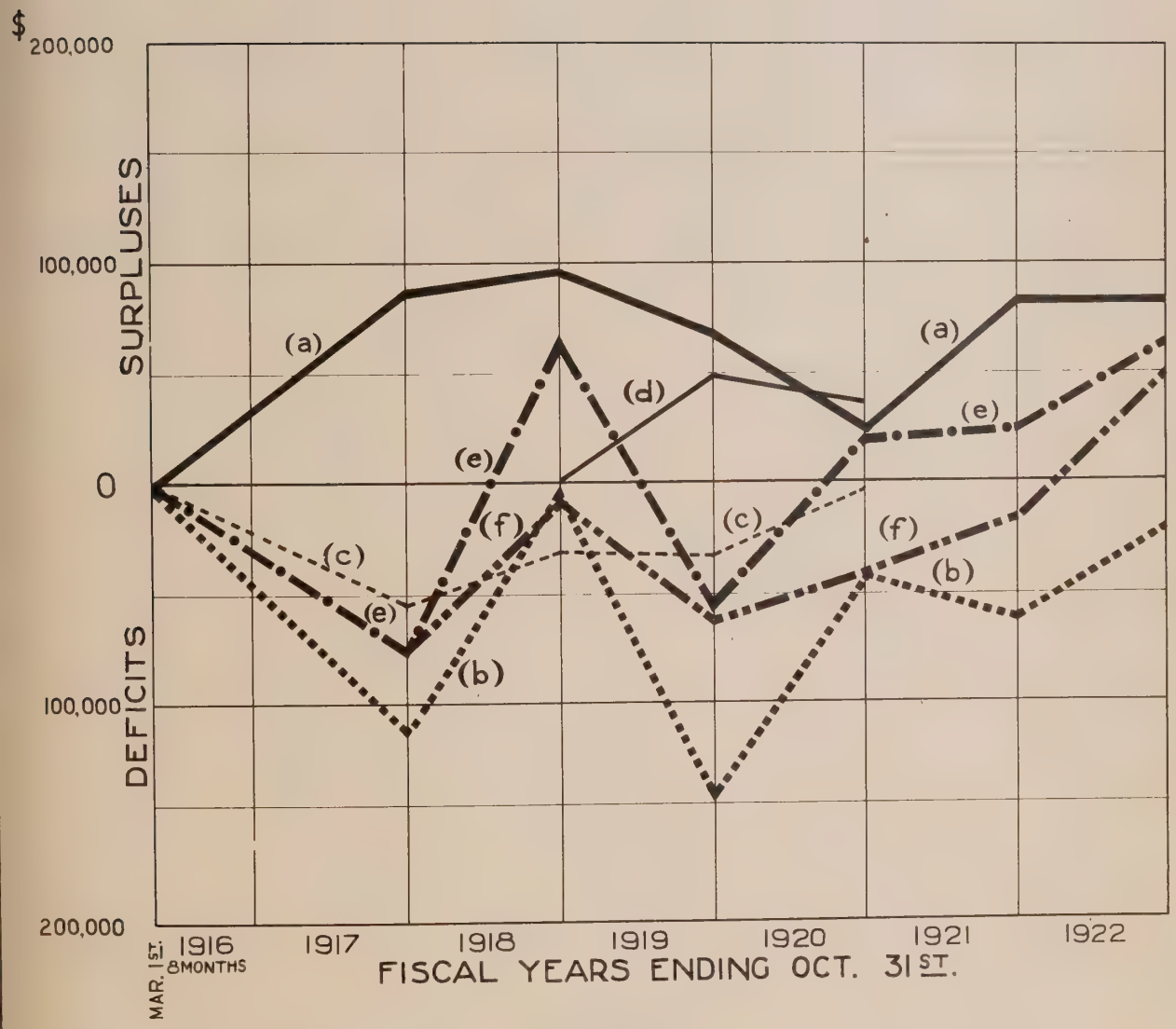
Department	Accumulated Resultant
Combined Electrical Department	$ 51,665.38 Surplus
Peterborough Radial Railway	130,450.52 Deficit
Campbellford Pulp Mill	41,389.76 Surplus

The diagrams on pages 94, 95 and 96 show the adjusted resultants in graphic form and should be studied with those on pages 59, 65 and 67 respectively, which show the figures as originally recorded in the books of the System.

Walter J. Francis

Consulting Engineer.

Toronto, January 13th, 1923.



Local Electric Systems
Power Adjustments
Water Rentals
Combined Annual Resultant
Accumulated Deficits or Surpluses
Power Department

Note:-
These curves include adjustments for Costs of Power for 1919 and 1920 for Peterboro Railway and for Campbellford Pulp Mill.

Hydro-Electric Inquiry Commission
W. D. Gregory, Chairman
Economics of H. E. P. C. Distribution Systems
Central Ontario System
Central Ontario Section
Annual & Accumulated Deficits and Surpluses, Electric Departments
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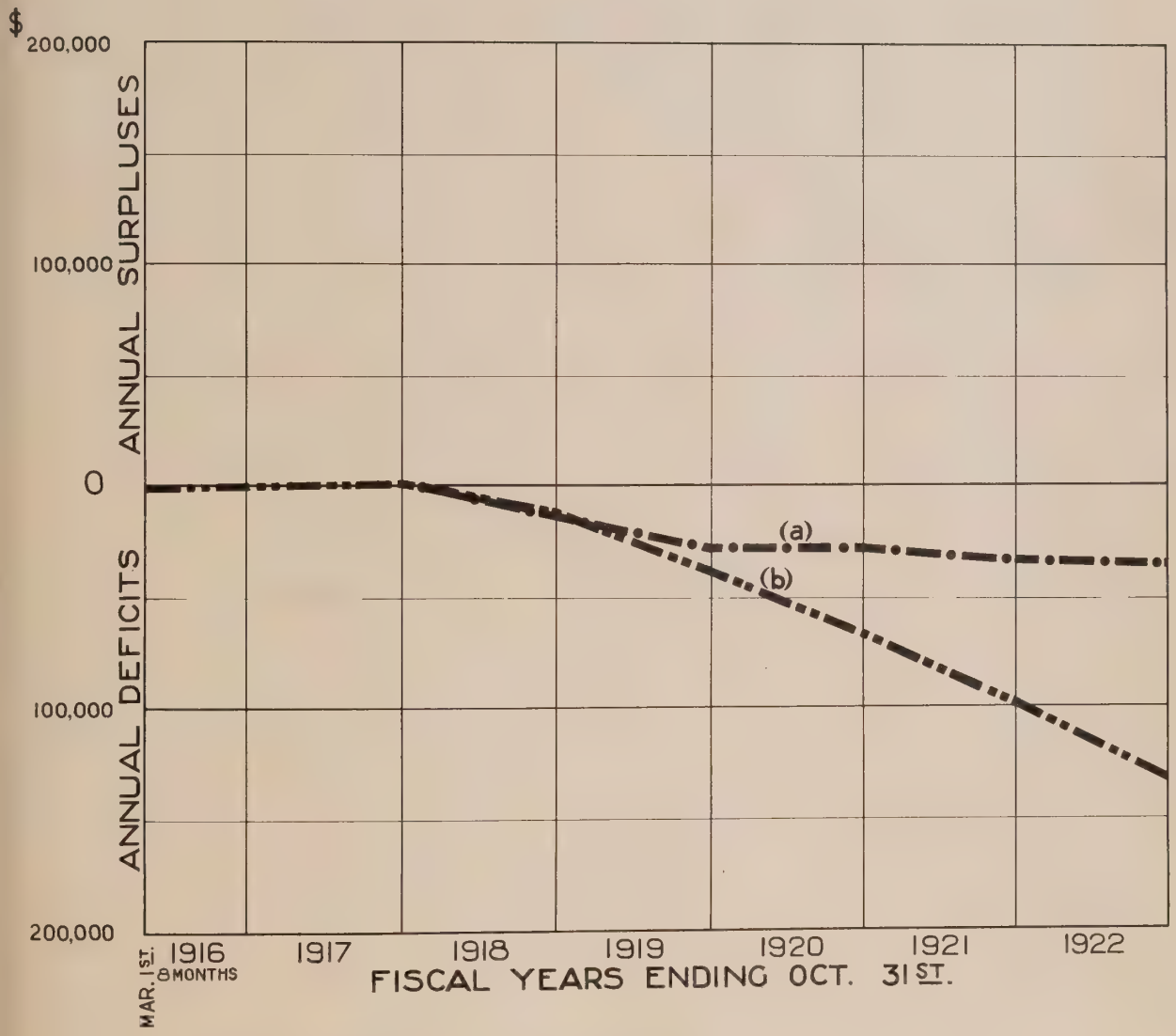

ANNUAL RESULTANT OF OPERATION
ACCUMULATED DEFICIT

NOTE:-
These curves include adjustments for Costs of Power for 1919 and 1920.

HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

ANNUAL & ACCUMULATED DEFICITS AND SURPLUSES, PETERBORO RAILWAY

Toronto, Jan. 13th., 1923. Made by E.C.O., Checked by

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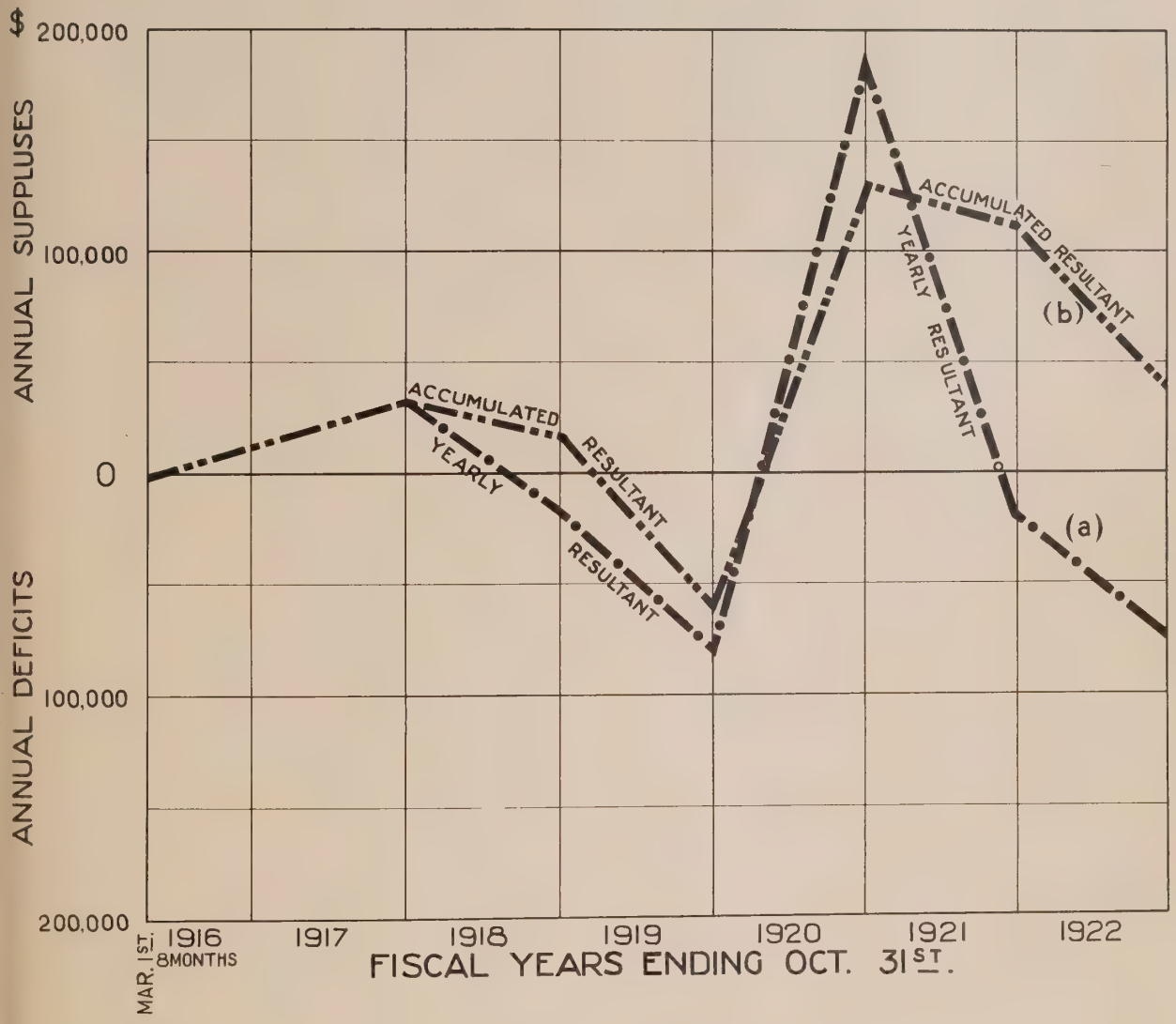

NOTE:-
These curves include adjustments for Costs of Power for 1919 and 1920.

HYDRO-ELECTRIC INQUIRY COMMISSION
W. D. GREGORY, CHAIRMAN

ECONOMICS OF H. E. P. C. DISTRIBUTION SYSTEMS

CENTRAL ONTARIO SYSTEM

CENTRAL ONTARIO SECTION

ANNUAL & ACCUMULATED DEFICITS AND SURPLUSES, PULP-MILL

Toronto, Jan. 13th, 1923. Made by E.W., Checked by L.L.

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